B & Z LIBRARY

1872

JAN 1 1 1957

The New World Species of *Chrysomela* L. (Coleoptera: Chrysomelidae)

OHIO STATE UNIVERSITY JAN 10 '57 LIBRARY

W. J. BROWN
Insect Systematics and Biological Control Unit,
Entomology Division, Ottawa, Canada

THE CANADIAN ENTOMOLOGIST
Volume LXXXVIII, Supplement 3
1956

The New World Species of *Chrysomela* L. (Coleoptera: Chrysomelidae)

by

W. J. BROWN
Insect Systematics and Biological Control Unit
Entomology Division, Ottawa, Canada

THE CANADIAN ENTOMOLOGIST
Volume LXXXVIII, Supplement 3
1956

CONTENTS

	PAGE
Introduction	5
Acknowledgments	6
Methods	7
Food-Plants	9
Life-Histories	10
Variation	11
Isolation and Hybridization	13
Species and Subspecies	15
Taxonomy and Nomenclature	16
Taxonomic Summary	18
Key to Species and Subspecies	21
Descriptions of Species and Subspecies	24
References	52

The New World Species of *Chrysomela* L. (Coleoptera: Chrysomelidae)[1]

By W. J. Brown[2]

Insect Systematics and Biological Control Unit
Entomology Division, Ottawa, Canada

INTRODUCTION

This paper offers a taxonomic treatment of the New World species of the Holarctic genus *Chrysomela* L. Twenty-one species and subspecies are recognized, of which ten, from the United States, Canada, and Alaska, are described as new. Three forms that have been considered varieties are recognized as species, and one specific and four varietal names are suppressed. Two new names are proposed for homonyms. Two species that were described in *Chrysolina* Mots. are transferred to *Chrysomela*, and one described in *Lina* Redt. (= *Chrysomela* L.) is transferred to *Microtheca* Stål. Confusion of American species with one another and with the Eurasian species *tremula* Fab., *saliceti* (Ws.), and *lapponica* L. is noted.

Of the 21 species and subspecies, *cruentipennis* (Duv.) is restricted to Cuba and *mexicana* n. n. (= *depressa* Suffr.) is known only from central Mexico and Central America. All of the others occur north of Mexico, *scripta* Fab. and probably *texana* (Schaeff.) extending into Mexico. Of the 19 that occur north of Mexico, three find their northern limits in the United States, and two are restricted to arctic regions of Alaska and Canada. The distribution of each is outlined in the taxonomic summary. The species have not received comprehensive treatment previously. Those of the United States have been treated by Rogers (1856, p. 37), by Suffrian (1858, pp. 387-391) who translated and amplified the treatment of Rogers, and by Crotch (1873, p. 53). Each of these authors recognized four species from the United States. Blatchley (1910, pp. 1160-1161), Beller and Hatch (1932, pp. 97-100), and Wilcox (1954, pp. 421-422) have treated the species of Indiana, Washington, and Ohio respectively.

The great confusion in the species is almost as old as their taxonomic history. The oldest of their names, *lineatopunctata*, has not been properly applied since it was proposed by Forster in 1771. All of the species of the United States and Canada were confused with their closest allies before Schaeffer segregated *immaculata* (= *schaefferi* n. n.) in 1920, and all other species described then or since were either considered varieties of others or were misplaced generically by their authors. Naturally the confusion has been great among the species allied to *interrupta* Fab., which are sibling to one another. These have been considered a single species by all authors except Knab and have been confused with the European species *lapponica* L. by many authors. In 1911 Knab wrote: "There are three distinct forms related to *lapponica* in the United States, the first occupying the region from Alaska to California, the second the Great Lakes region to New England, and the third the South Atlantic States and Middle West, northward to the lakes. Their food-plants, the willows . . . ". Knab segregated sibling species in the allied genus *Calligrapha* Chev., but he lacked suitable material for a better understanding of those of *Chrysomela*. Similarly, the American species allied to the European species *tremula* Fab. have been confused with one another and with their European allies.

1Contribution No. 3390, Entomology Division, Science Service, Department of Agriculture, Ottawa, Canada.
2Senior Entomologist.

ACKNOWLEDGMENTS

The study was in progress for twenty years, during which many individuals and institutions contributed to it. Most of the Canadian and much of the Alaskan material used was obtained during that period. Outstanding among the collections made then are those from the Northern Insect Survey, which is a co-operative project of the Canada Department of Agriculture and the Defence Research Board, Canada Department of National Defence. Those who participated in this northern collecting are: Dr. W. R. M. Mason, Dr. J. R. Vockeroth, and Messrs. W. E. Beckel, F. G. DiLabio, D. F. Hardwick, W. G. Helps, S. D. Hicks, J. F. McAlpine, and J. B. Wallis. Others of the Entomology Division, Canada Department of Agriculture, who collected on request material of special value are: Messrs. P. F. Bruggeman, L. A. Kelton, R. de Ruette, G. S. Walley, and Dr. E. C. Becker of Ottawa, Ont.; Mr. D. Arnott, Kamloops, B.C.; Mr. A. R. Brooks, Saskatoon, Sask.; and Dr. G. A. Hobbs, Lethbridge, Alta. Special collections were supplied also by Messrs. C. A. Frost of Framingham, Mass., E. J. Kiteley of Minneapolis, Minn., G. Stace Smith of Creston, B.C., and Manuel Barro of Havana, Cuba.

Officers of the Forest Biology Division, Science Service, were most helpful. Mr. H. B. Leech supplied special collections and live material when stationed at Vernon, B.C. Others of the Division who supplied material of special value are: Messrs. D. Evans, Victoria, B.C.; W. H. Haliburton, Ottawa, Ont.; and J. M. T. Hughes, Vernon, B.C. Dr. W. Y. Watson of Sault Ste Marie, Ont., and Dr. W. C. McGuffin of Calgary, Alta., supplied specimens from collections of the Division's laboratories.

The collections of many institutions and private collectors were made available. The author was privileged to study types and other material in their charge by Dr. E. A. Chapin, United States National Museum; by the late H. S. Barber, U.S. Bureau of Entomology and Plant Quarantine, Washington; by Dr. P. J. Darlington, Jr., Museum of Comparative Zoology, Cambridge, Mass.; and Mr. H. B. Leech, California Academy of Sciences, San Francisco. Dr. M. A. Cazier and Mr. J. C. Pallister of the American Museum of Natural History, New York, N.Y., and Dr. C. D. Michener of the University of Kansas, Lawrence, permitted study of the collections in their charge. The collections of their institutions were sent on loan by Dr. A. T. McClay, University of California, Davis, by Dr. J. A. Wilcox, New York State Museum, Albany, by Mr. O. L. Cartwright, then of Clemson College, South Carolina, and by Prof. E. H. Strickland, then of the University of Alberta, Edmonton. Dr. G. E. Ball, then of Cornell University, Ithaca, N.Y., and Dr. J. G. Edwards, San Jose State College, California, supplied special material from their private collections. Dr. Melville H. Hatch, University of Washington, Seattle, compared specimens with the type of his *Chrysolina engelhardti*. Mr. J. A. Calder, Botany Division, Canada Department of Agriculture, assisted with the identification and nomenclature of plants.

Most of the collections and field studies made by the author were accomplished during work on projects of the Entomology Division and the Northern Insect Survey. The author is grateful to officers of these organizations for their co-operation, especially to Dr. J. H. McDunnough, former Chief of the Systematic Entomology Unit, and to Mr. G. P. Holland, Head of the Insect Systematics and Biological Control Unit, Ottawa; to Dr. T. N. Freeman, Entomology Division, Ottawa; and to Mr. A. C. Jones, Defence Research Board, Ottawa.

The author wishes to pay tribute to the work of the late Frederick Knab, the late Benjamin D. Walsh, and Dr. William Colcord Woods. As has been noted above, Knab (1911) recognized the species allied to *C. interrupta* as a complex of siblings. Walsh (1864) was many years ahead of his time in his concepts concerning the nature of species. The species herein described as *walshi* n. sp. is an ideal example of his "phytophagic species." Woods (1918, 1924) applied most successfully a field approach in taxonomic studies on *Altica* Geoffr. and *Galerucella* Crotch and demonstrated a method of arriving at a sound knowledge of species in some difficult groups. These men were able field naturalists, and this is reflected in their taxonomic work.

METHODS

Most of the species of *Chrysomela* lack striking morphological characters. Some of them are siblings that are distinguished well by their food-plants or distributions but very poorly by the characters of museum specimens. These characteristics of the species are given in the taxonomic summary. The siblings appear to differ in museum specimens only by inconstant colour characters, and they vary in colour both within populations and geographically. Many specimens cannot be identified if their food-plants and localities are unknown. Because of this, it was necessary to work out much of the taxonomy in the field and the laboratory.

The method of studying the siblings allied to *C. interrupta* consisted essentially of comparing the populations of one locality and relating them to one another and to specimens collected elsewhere. In the Ottawa district, colonies of *Chrysomela* are common on *Alnus rugosa*. These colonies agree well with one another and certainly represent a single species, which is described herein as *alnicola alnicola* n. sp., s. str. Infrequently near Ottawa, colonies occur on *Populus balsamifera;* all stages of the insects from these agree well with specimens from *Alnus rugosa* except the adults, which average darker and slightly larger. Some adults from the two food-plants cannot be distinguished. Adults from both plants were confined for eggs, and some of their larvae were reared, with moderate mortality, on the parental food-plants. When hatching egg masses of *a. alnicola* were placed on *P. balsamifera*, the larvae fed for a few hours only and died without growing. Except rarely, newly hatched larvae of the *Populus*-feeder died without growing when confined on *A. rugosa*. Two species are indicated; the form from *P. balsamifera* is described as *walshi* n. sp.

A single colony of *Chrysomela* was found on *P. balsamifera* in southernmost Ontario at Delhi. In this colony the adults average darker, and the eggs sometimes differ in colour; otherwise the colony is similar to those of *walshi*, and it is referred to that species. The common *Chrysomela* of the Delhi district is a *Salix*-feeder that differs greatly from *walshi* in its colour variation in eggs, larvae, and adults. But all specimens of all stages from *Salix*, except the darkest adults, are indistinguishable from some specimens of *walshi*. The *Salix*-feeder has a more southern distribution; in Eastern Canada it is restricted to southernmost Ontario. The two forms can be reared with equal success on the food-plant of either, but they are not known to breed on the same plant in nature. Colonies of the two were separated by a distance of only 100 feet at Delhi. Two species are indicated; the *Salix*-feeder is described as *knabi* n. sp.

C. knabi is common in the eastern United States, where its range approaches and perhaps overlaps that of the southeastern species *interrupta* Fab. A few adults of *interrupta* resemble some of *knabi*, but *interrupta* feeds on *Alnus serrulata*. The two are obviously distinct, for *knabi* cannot be reared on *Alnus*

rugosa, which is accepted by all of the Canadian *Alnus*-feeders. The range of *interrupta* approaches that of *a. alnicola*, but they are obviously distinct. They differ strikingly in size and colour; they show no intergradation; and their ranges are very different.

In the Kenai Peninsula of Alaska, colonies were found abundantly on *Salix* and *Populus trichocarpa*. Series taken from the two food-plants, where they were intermixed in large, populous colonies of the beetles, are indistinguishable. The adults are extremely variable, but the range of variation and the frequency of the variants are the same in series from the two plants. Larvae from the two plants are also similar and vary in a similar way. When the two plants were intermixed, the insects always occurred in similar numbers on both. Confined adults and larvae showed no preference for either food-plant. A single species showing no preference between *P. trichocarpa* and certain species of *Salix* is indicated; it is described as *falsa* n. sp. In one very large and populous colony of *falsa*, which occurred on both food-plants, adults appeared and bred on *P. tremuloides* after the other plants were occupied. Series of all stages from *P. tremuloides* are indistinguishable from series taken from the other plants and are referred to *falsa*. Small colonies of *falsa* frequently showed restricted variation in the colour of adults, probably because such colonies are established by single females that do not carry the total variability.

Also in the Kenai Peninsula, a single colony was found on *Alnus tenuifolia*. The adults from this colony show restricted variation as compared to some of the series of *falsa*, and are inseparable from series taken from some small colonies of *falsa*. Most of the mature larvae from *Alnus* differ in colour from most of those of *falsa*. Larvae of the *Alnus*-feeder were reared with moderate mortality on P. *trichocarpa*, but larvae of *falsa* could not be reared satisfactorily on *A. tenuifolia*. The *Alnus*-feeder is described as *alnicola interna* n. subsp.

Series found on *Populus* and *Salix* from Alaska to Newfoundland agree well or fairly well with the types of *falsa* and are referred to that species. At Gander, Nfld., *falsa* and *a. alnicola*, which differ strikingly in colour, were found on *Salix discolor* and *Alnus rugosa* respectively where those plants were intermixed. Each species was observed only on its normal food-plant. Newly hatched larvae of both were reared without mortality on their natural food-plants, but larvae of neither could be reared on the food-plant of the other. The two are obviously distinct.

Large numbers of specimens have been associated with all of these species, as represented by the colonies compared in the field and the laboratory, on the basis of their colour characters, localities, and, when known, their food-plants. With reasonable caution such associations can be made safely; the possibility of error is negligible when population samples from known food-plants and localities are associated, unless undetected siblings exist. Three forms of the *interrupta* group, *interrupta* Fab., *alnicola littorea* n. subsp., and *aeneicollis* (Schaeff.), have not been observed in nature by the author. As noted above, *interrupta* is distinct enough, and the others are well differentiated by their food-plants, distributions, and size and colour characters.

The species of *Chrysomela* are readily reared in the laboratory. Adults were confined for eggs in glass jars, and immature stages were kept in glass-topped tins. These tins were an inch deep and three inches in diameter, and had a glass insert in the top; a lining of blotting paper on the bottom absorbed excess moisture. The adults laid freely on the leaves that were supplied for food and on the soft paper with which the jars were partially lined. Eggs were

removed daily and were retained, on the leaf fragment or paper to which they were attached, in glass-topped tins. When an egg mass began to hatch, it was placed upon leaves of the food-plant in a tin. The larvae were given fresh food at least every second day and were transferred occasionally to clean tins. They pupated in the tins. Results of the feeding tests that are mentioned above are given in detail in the descriptions of the species.

FOOD-PLANTS

The food-plants of the American species of *Chrysomela* are certain species of *Salix*, *Populus*, and *Alnus;* in Eurasia *Betula* serves in addition. Certain species of *Chrysomela* are restricted to each of the food-plant genera. Certain species breed on both *Salix* and *Populus*, but the *Alnus*-feeders never breed on the other genera, although very rarely adults of some feed on *Salix* in early spring. Some species can be reared on plants that they avoid entirely in nature; the preferences of the beetles are not conditioned by rearing on unnatural food-plants. The food-plants and results of tests with unnatural foods are given with the descriptions of the species; the food-plants are summarized in the taxonomic summary and again, for the *interrupta* group, in the key to the species. The records from *Salix* are unsatisfactory because the plants are seldom determined to species. It is often difficult or impossible to determine whether a plant is neglected because it is unattractive to the beetles or because the beetles, being gregarious, have simply restricted themselves to other plants.

No species, as far as known, feeds indiscriminately on all available species of its host genus or genera, and one species, *C. walshi*, appears to be monophagous. The *Alnus*-feeders, in Canada and Alaska at least, restrict themselves to hosts with soft leaves, and the *Salix*-feeders usually to hosts with glabrous leaves. Newly hatched larvae of the *Alnus*-feeding subspecies *a. alnicola*, given *Alnus crispa* at Gander, Nfld., persisted at feeding but seemed to find the leaves too hard and died in the first and second instars. Adults of *a. interna*, which were breeding on *A. tenuifolia* at Cooper Landing, Alaska, did not feed while confined for 24 hours on *A. sinuata*. Larvae of *a. littorea*, from adults breeding on *A. oregona* near the Sarita River, Vancouver Island, did not feed while confined on *A. crispa* var. *mollis*. At Moose Pass, Alaska, *falsa* avoided entirely a species of *Salix* with pubescent leaves, but its larvae were found and reared on two pubescent species in northern Labrador. Apparently no species feeds on *S. Bebbiana* Sarg., which has strongly pubescent leaves. Adults and larvae of all species often show preference for the tender, immature leaves of their food-plants, and the adults of at least three species, *scripta*, *laurentia*, and *lineato-punctata*, sometimes feed on the tender bark of terminals in early spring. As noted in the descriptions, *knabi* and *laurentia* restrict their feeding to favoured species or to tender parts of secondary food-plants when the leaves mature; other *Populus*- and *Salix*-feeders probably do likewise.

When abundant the beetles normally do not populate their food-plants to the extent that larvae suffer from lack of food. When abundant *falsa* may expand its feeding tolerances like some other chrysomelids. Colonies of *falsa*, mostly small, were plentiful in the Kenai Peninsula, Alaska, in 1951 on *Salix* and *Populus trichocarpa*. In a very large and populous colony at Moose Pass, *falsa* bred abundantly upon *P. tremuloides* after it had infested the other food-plants. *P. tremuloides* is abundant on the Peninsula, but the beetle was not found on it elsewhere there.

Damage due to the feeding of *Chrysomela* is rarely important. Bruner (1890, p. 83) and Packard (1890, p. 428) have described great damage caused

to "tree claims" by outbreaks of *scripta* in the prairie states during the 1880's, and Lowe (1898) has described damage to basket willow in New York.

LIFE-HISTORIES

The life-histories of the American species of *Chrysomela* are very poorly known. The most comprehensive study is that of Lowe (1898), which refers to *lineatopunctata*. Other authors who deal primarily with life-histories are Riley (1880) and Packard (1890, p. 428) who studied *scripta*, and Bruner (1890, p. 83) who studied *scripta* and *knabi* (these authors write of the habits of *scripta*, but their figures and descriptive and distributional notes refer in part to *texana*, *confluens*, and *lineatopunctata*). Others have published fragmentary notes on life-histories, but most of them have depended on Riley, and it is often impossible to identify the species concerned. The European species have received more study; the most comprehensive paper, on *aenea* L., is that by Lipp (1935).

The life-histories of all species are similar and are usually exactly the same in all species at any one locality. The winter is passed by sexually immature adults beneath cover. *C. laurentia* has been found in a crow's nest and beneath thick bark of dead maples. *C. texana* has been found beneath the bark of willow, and Lowe (1898) found *lineatopunctata* under logs, under bark, in crevices of fence rails, and even under stones. In *laurentia* at least, several individuals usually hibernate together. The beetles leave their winter quarters when the new growth starts and form colonies on the food-plants. The colonies may be diffuse or restricted and may or may not be populous. They usually occur year after year on the same trees. Mating begins soon after the beetles have fed, and the first eggs are laid a week later. The eggs are deposited in masses, usually of 25 to 50, on the leaves of the food-plant; each of the elongate eggs it attached at one end to the leaf, and the eggs stand in a vertical or inclined position. There are three larval instars. In the first instar the larvae feed on the epidermis of the leaf with their bodies in contact with one another. During the second they separate and begin to consume the entire leaf except the veins. The mature larva attaches itself by its caudal disc to a leaf and becomes a prepupa. The pupa remains on the leaf in the anterior portion of the larval skin. There is one or more generations annually, depending on species and locality. There is no evidence of parthenogenesis. The wings are functional in all individuals of all species, but the beetles are not known to fly except when going to and from winter quarters. Breeding adults do not leave their food-plants except when disturbed or beaten off by storms.

In the Ottawa district *a. alnicola*, *walshi*, *laurentia*, and *lineatopunctata*, and in southern Ontario *knabi* and *walshi*, usually begin to leave their winter quarters during the last days of April, and the colonies become established during the first week of May. A small number of eggs are laid during the following week. By June 10 laying is virtually completed, and the hibernated adults are dying rapidly. Larvae are abundant by the end of the third week of May, and they mature in numbers during the second week of June. After the third week of June there are no larvae except stragglers. New adults appear during the first week of June and become numerous during the third week of that month. The beetles begin to desert the food-plants during the last week of June, and, except for a very few stragglers, all are in winter quarters by July 15. Unseasonable cold sometimes delays development during May. Very rarely an adult or a group of larvae is found during late July; these probably represent a second generation, but normally there is a single generation annually. In the interior

of the Kenai Peninsula, Alaska, *a. interna* and *falsa* appeared on their food-plants during the first week of June in 1951 and began to lay during the following week; the first hatching was noted on June 28, and, during the third week of July, the colonies consisted almost entirely of mature larvae. At Gander, Nfld., in 1948, eggs and newly hatched larvae of *a. alnicola* and *falsa* were first seen during the first week of July. Near Syracuse, N.Y., Lowe (1898) found that *lineatopunctata* emerged from hibernation during late April and early May; he found eggs as late as June 24 and adults into early August.

In Canada and Alaska all species are known to have or appear to have a single generation annually except *scripta* and, in southwestern Canada, *knabi* and *schaefferi*. The occurrence of adults in late summer suggests more than one generation except in northern regions. *C. scripta* is taken in late summer throughout its Canadian range, and individuals reared from Albertan specimens mated and laid freely two weeks after emerging from their pupae. *C. knabi* has been taken in late July in southernmost Saskatchewan, and *schaefferi* is taken in August in the southernmost parts of Alberta and British Columbia; both species are known to have single generations in the eastern parts of their ranges. All Canadian species of the *interrupta* and *scripta* groups, except the arctic species *blaisdelli*, have been reared in the laboratory, and all reared specimens except those of *scripta* have become dormant from 10 to 17 days after emergence and before becoming sexually active. Rearing *confluens* at Stanford University, Calif., McCracken (1905) obtained five generations before dormancy occurred. Lowe (1898) suspected that there were two generations of *lineatopunctata* at Syracuse. Bruner (1890) reported three generations at least for *scripta* in Minnesota and the Dakotas and four or five farther south; he reported the adults active until after the first heavy frosts.

In confinement breeding adults live and lay much longer, and their progeny develops more rapidly, than in nature. All species developed similarly in the laboratory. The eggs hatched in four or five days; the larvae pupated after 10 to 15 days; and the pupae required from three to five days.

The species of *Chrysomela* have remarkably few enemies. Riley (1890, p. 430) reported that adults of the coccinellid "*Megilla maculata*" (= *Coleomegilla maculata lengi* Timb.) feed on larvae and pupae of *scripta*, but this has not been confirmed by others. The author has never seen any predator attacking any stage of *Chrysomela*, the larvae of which have protective glands. Hinton (1951) has described the protection afforded to the pupa by the glands of the larval skin that encloses it. Cushman (1917) reported the pteromalid *Schizonotus sieboldi* (Ratz.) attacking the pupae of "*Melasoma interruptum*" (= *C. a. alnicola*) at North East, Pa., and the same species attacks *scripta* according to Dowden (1939, p. 582). The pteromalid *Erixestus winnemana* Cwfd. has been reared from eggs of *C. lineatopunctata* collected near Ottawa, and the tachinid *Hyalomyodes triangulifer* (Loew) was reared from an adult of *C. knabi* taken at Point Pelee, Ont. In the Ottawa district at least, the most important checks on *Chrysomela* are climatic. Larvae are beaten from the food-plants by storms, and many adults die in winter quarters.

VARIATION

In *Chrysomela* great variation in colour occurs in all stages. In addition to variation of a continuous type, striking dichromatism occurs in eggs, larvae, and adults. There is also considerable geographic variation.

All eggs of any mass are similar in colour. In the *interrupta* group, the masses usually vary from whitish to very pale yellow. Rarely deep yellow

masses are produced by *a. interna* and *walshi*, and very pale green masses by *falsa;* in *knabi* the masses are nearly always deep yellow, very rarely whitish. In the *scripta* group there is striking dichromatism. The masses are either pink or deep yellow in *laurentia* and *semota*, and usually in *lineatopunctata*, which produces pale green masses very rarely. The eggs of *scripta* are apparently always deep yellow.

In most species and subspecies of the *interrupta* group, the larvae of the third (last) instar are dichromatic and are either very pale or blackish. Paleness results when dark pigment fails to develop after the second moult. All egg masses of *a. alnicola* and *walshi* from which mature larvae were reared produced larvae of both types, but in some species larvae of one form or the other are very rare.

Adults vary in colour with their degree of maturity. In the *interrupta* group the pale parts of newly matured beetles are dull yellow. The pale parts become reddish after the beetles have fed for several days, and they become a deeper red when the beetles mature sexually. In the maculate species of the *scripta* group, the pale parts of newly matured adults have a gray, greasy appearance. Later the pale parts become whitish. In breeding adults the prothoracic sides and the lateral ridge of each elytron are pale red, and the pale parts of the elytral disk are silvery white. Because the nuptial colours of all species are largely lost in pinned specimens, little mention is made of them in the descriptions that follow.

The elytra and pronotum are dichromatic in *confluens*, and, in most of the species of the *interrupta* group, the elytra are dichromatic. In *confluens* the elytra are entirely blue or blue-green, or each shows seven spots and a sutural stripe (Fig. 35) on a pale ground; the prothoracic sides are nearly always broadly pale, but the prothorax is very rarely entirely dark in the form with unicolorous elytra. McCracken studied the inheritance of this variability. She (1905, 1906) found maculate elytra dominant to blue and (1907) pale prothoracic sides dominant to dark. Her ratios were not strictly mendelian, probably because uncontrolled matings resulted from her practice of distinguishing the sexes by size. In the *interrupta* group there is a basic pattern of seven dark spots on each elytron (Figs. 7-20, 22-28), although the spots are usually fused in part. In some individuals only the two median spots of each elytron develop (Figs. 21, 29), and the ground colour is then either reddish-yellow or orange, rather than red, in breeding individuals. Such individuals are termed 'quadrimaculate' in the descriptions of the species. The progeny of field-mated quadrimaculate females of *knabi* and *falsa* were reared with the following results: at Jordan, Ont., one female of *knabi* produced 40 individuals of each colour form; at Gander, Nfld., one female of *falsa* produced 39 quadrimaculate and 38 fully maculate individuals, another produced 48 quadrimaculate and 40 fully maculate individuals, a third produced 28 quadrimaculate and 47 fully maculate offspring. The quadrimaculate form constituted about 3.2 per cent of the populations of *knabi* in Ontario and about 3.8 per cent of those of *falsa* at Gander. If, as was probable in those areas, the quadrimaculate females were heterozygous and had mated with homozygous, fully maculate males, a one-to-one ratio in the progeny would indicate that the quadrimaculate condition is a mendelian dominant.

The adults of the presumed subspecies and of many of the species vary geographically, and this variation is great in several. Some of the variation is not clearly clinal, but the clines observed are simple and pose no problems. They concern the relative extents of pale and dark areas on the body and

appendages of adults and the frequency of dimorphous forms in adults and possibly in eggs and larvae. Three of the eastern species, *knabi*, *scripta*, and *lineatopunctata*, show clines and extend onto the Great Plains, where adults of all are paler than in eastern regions. The frequency of quadrimaculate elytra varies geographically in most of the species in which the character occurs; the frequency is always relatively high on and north of the Great Plains.

ISOLATION AND HYBRIDIZATION

The ecologic and ecogeographic isolation of the species of *Chrysomela* is striking. When two or more species of the *interrupta* group occur in one locality, they breed on different food-plants, with few possible exceptions. Two or more *Salix*-feeding species of the *scripta* group frequently occur in one locality, but mixed breeding colonies of these or of more distantly related species are very rare, in Canada at least. Rarely, a few examples of *laurentia* and *lineatopunctata* are found together in the Ottawa district, usually on *Populus balsamifera*, which is a secondary host of both. These species are common in the district, but populous colonies of *laurentia* have been found only on *Salix* spp. growing on the borders of streams and lakes, and populous colonies of *lineatopunctata* only on *Salix* growing in marshes. The two species prefer either different habitats or different species of *Salix*. Adults of *laurentia* and *walshi* have been observed together on *P. balsamifera* near Ottawa in early spring. On this plant adults and larvae of *laurentia* feed only on immature leaves and sucker growth; those of *walshi* show preference for tender growth but do not avoid the mature leaves. Both *knabi* and *scripta* breed on *Salix* spp. in much of eastern and central United States and in southernmost Ontario, but their requirements have not been compared. They often feed in mixed colonies in Kansas in early spring, but they are not known to breed in mixed colonies. The *Alnus*-feeders replace one another geographically. A number of the *Salix*-feeders replace one another geographically or show only slight overlap in ranges. The ranges of *scripta* and its sibling *laurentia* and of *knabi* and its sibling *falsa* are separated by distances of at least 100 and 300 miles respectively in Ontario, though barriers are lacking and preferred species of *Salix* are abundant in the intervening areas.

Species discrimination appears to be weak in *Chrysomela*, and it is possible that ecologic isolation, rather than sexual isolation, prevents the sibling species from hybridizing freely. Although cross-mating is rare in nature, it may be significant at times. Some siblings hybridize freely in the laboratory, and there is evidence that introgressive hybridization may occur in nature. Davis (1920) reported a male of "*interrupta*" (= *knabi*) apparently in copulation with a female of "*tremulae*" (= *crotchi*) at Westpoint, N.Y. The author found a male of *walshi* apparently copulating with a female of *laurentia* at Arnprior, Ont. In April in Kansas, the author found a mixed colony of *knabi* and *scripta* feeding and copulating on *Salix* switches. Four pairs that were apparently cross-mated were observed; three males of *knabi* and one of *scripta* were mounted on females of the other species. Copulation may have been at random, without species discrimination. In all of these examples the cross-mated species are distantly related and certainly do not hybridize. In mixed laboratory cultures of such distantly related species (*laurentia* and *a. alnicola*, *laurentia* and *lineatopunctata*), males were attracted only by females of their own kind for several days, after which they lost ability to discriminate. When males of *a. alnicola* or *walshi*, which are sibling to one another, were confined with females of both, they showed no species discrimination. However, breeding adults, when

confined, become excited sexually and copulate much more freely than in nature. Periods of comparable excitement probably occur rarely in nature. The author once observed a comparable situation, when copulation was exceedingly common in colonies of *a. alnicola* and *falsa* at Gander, Nfld., during several unusually warm and sunny days. The Kansas observation described above is probably a comparable case.

C. a. alnicola was hybridized with both *walshi* and *falsa* in the laboratory. Females of *a. alnicola* that had mated in the field were collected at Arnprior, Ont., from *Alnus rugosa* and were confined with males of *walshi* from the same locality. Two cultures, each with five females and ten males, were set up. Larvae from the cultures were given *Populus balsamifera*, the food-plant of *walshi*. An egg mass from a culture 24 hours old produced 14 larvae, which died without growing after scant pinprick feeding as larvae of *a. alnicola* always do on *P. balsamifera*. Five masses, obtained when the cultures were from five to eight days old, produced 76 larvae, of which 55.2 per cent (42) died in the first instar. Some larvae from all masses attained the third (last) instar, and four of the masses produced a total of 12 adults. Survival to the adult state ranged from 0.0 per cent to 53.8 per cent and averaged 15.8 per cent. Eleven masses, obtained when the cultures were from 10 to 14 days old, produced 175 larvae, of which 28.6 per cent (50) died in the first instar. All masses produced pupae, and ten of the masses produced a total of 61 adults. Survival to the adult state ranged from 0.0 per cent to 70.0 per cent and averaged 34.8 per cent. Because larvae of *a. alnicola* cannot survive on *P. balsamifera*, all of these adults and all (159) larvae that attained the second instar are presumed to be hybrids.

Progeny of the reciprocal cross showed greater survival. Females of *walshi* that had mated in the field were collected at Arnprior and were confined with males of *a. alnicola* from the same locality. Two cultures, each with five females and ten males, were set up. Larvae from the cultures were given *Alnus rugosa*. An egg mass taken from a culture 24 hours old produced 16 larvae, which died without feeding, as larvae of *walshi* often do on *A. rugosa*. Four masses, obtained when the cultures were from five to eight days old, produced 92 larvae, of which 33.6 per cent (31) died in the first instar. All masses produced adults; survival to the adult state ranged from 10.0 per cent to 92.0 per cent and averaged 47.8 per cent. Nine masses, obtained when the cultures were from 10 to 14 days old, produced 172 larvae, of which 16.2 per cent (28) died in the first instar. All masses produced adults; survival to the adult state ranged from 20.0 per cent to 94.4 per cent and averaged 78.5 per cent. Most of the adults are presumed to be hybrids, because, of 1,155 larvae of *walshi* that were fed *A. rugosa*, only 1.3 per cent (15) attained the adult state.

Females of *falsa* that had mated in the field were collected at Gander, Nfld., from *Salix discolor* and were confined with males of *a. alnicola* that had been taken from *Alnus rugosa* at the same locality. One culture, consisting of five females and seven males, was set up. An egg mass, obtained when the culture was seven days old, produced 27 larvae, which were reared to the second instar on *A. rugosa* and then transferred to *S. discolor*. Seven of the larvae died in the first instar, and 19 attained the adult state. Such survival indicates hybridization, because *falsa* from Gander showed a mortality of approximately 95 per cent in the first instar on *A. rugosa*. Four other egg masses, obtained when the culture was from 19 to 25 days old, produced 79 larvae, which were reared on *S. discolor*. Seventy of these attained the adult state, and it is presumed that most of them are hybrids. Only 12.8 per cent (9) of the

adults have the femora entirely and the underside almost entirely dark, against 67.7 per cent for the series of *falsa* collected at Gander, and 87.1 per cent have the legs entirely and the underside largely to entirely pale, against 1.2 per cent (two specimens of 158) for the collected series. The dark areas of the elytra are much less extensive than in the collected series; the reared series are obviously at least 80 per cent hybrid and are intermediate in colour between the parent species.

Considering the role of ecologic isolation and the possibility of introgression, it seems possible that the isolation may break down occasionally. The beetles hibernate as sexually immature adults but mate very soon after feeding in the spring and continue to mate at intervals for several weeks. One species may come into contact with another while feeding briefly on the food-plant of the other in early spring, or while beetles are re-establishing themselves after being dislodged from their food-plants. And species discrimination appears to be weak. *C. walshi* is known only from the Ottawa Valley, other parts of easternmost Ontario, and southernmost Ontario. It breeds on *Populus balsamifera* and appears to be monophagous. Its colonies are rare, and its siblings *a. alnicola* and *knabi* occur near it where their food-plants grow with or near the food-plant of *walshi*. These siblings are abundant, *a. alnicola* on *Alnus rugosa* in easternmost and *knabi* on *Salix* in southernmost Ontario. In each region *walshi* varies toward the sibling with which it occurs. In easternmost Ontario adults of *walshi* average darker and a trifle larger, and the larvae, at some localities at least, are more frequently of the dark form; otherwise *walshi* and *a. alnicola* are inseparable. At Delhi, Ont., *walshi* differs in sometimes having the eggs deep yellow, in having the adults darker still and sometimes with quadrimaculate elytra, and possibly in having the larvae more frequently dark. Deep yellow eggs, dark larvae and adults, and quadrimaculate elytra are characteristics of *knabi*, with which *walshi* occurs in that region. *C. knabi* commonly feeds on *Populus* spp. in early spring and in Kansas rarely cross-mates with *scripta*, to which it is not closely allied. It is therefore possible that *knabi* has invaded the colony of *walshi* at Delhi and that some introgressive hybridization has resulted.

When newly hatched larvae of *walshi* are fed *Alnus rugosa*, the survival of some larvae from some egg masses suggests the possibility of introgression. Sixty-five egg masses of *walshi* taken from females collected at Arnprior, Ont., where *a. alnicola* is abundant, produced 1,155 larvae that were given *A. rugosa*. All larvae from 24 of the masses died in the first instar after little or no feeding. Total mortality in the first instar was 84.8 per cent. Five of the masses produced 21 pupae, from which 15 adults were reared. The adults appeared to be normal.

Introgression, if it occurs, is of course influenced by the viability and fertility of the hybrids. In laboratory rearings, hybrid larvae of *walshi* ♂ X *a. alnicola* ♀ suffered heavy mortality; only 45.9 per cent of 159 second-instar hybrid larvae attained the adult state, whereas 86.0 per cent of 129 larvae from field-mated females of *a. alnicola* became adult. However, presumed hybrids of *a. alnicola* ♂ X *walshi* ♀ and *a. alnicola* ♂ X *falsa* ♀ survived as well as the progeny of field-mated females of most species. Nothing is known of the reproductive potential of hybrids produced in the laboratory.

SPECIES AND SUBSPECIES

If a species is a group of populations that share a common gene pool and are reproductively isolated by their physiologic qualities from the populations of other such groups, reproductive behaviour and opportunity, and factors that

influence them, assume an importance to which all other matters are secondary. The behaviour of *Chrysomela*, which has been described above, indicates that the most effective isolating factors are ecologic (food-plants) and ecogeographic (distribution). All reproductively isolated populations have diverged sufficiently to show morphological differences in *Chrysomela*, in which even the sibling species, in some stage or to some degree, differ in colour. In the siblings the differences are often obscured by variation both individual and geographic. Specifically distinct adults may be inseparable even in series (*a. interna* and *falsa* where they are sympatric; *a. interna* and *walshi*, which are allopatric), and segments of a clinal gradation may differ as much as relatively well-characterized species (eastern and western populations of *knabi*). When sympatric populations are compared in the field and the laboratory, or when the morphological clues are stronger, specific limits become plain enough.

When clines are unknown and food-plants are similar, the status of allopatric populations may be difficult to evaluate. The northern *falsa* and its alpine sibling *aeneicollis*, and the northern *semota* and its southern sibling *confluens*, simulate segments of clinal gradations, but differences in food tolerances suggest that the siblings of each pair are specifically distinct. The northern *falsa* and its southern sibling *knabi*, and the northern *laurentia* and its southern sibling *scripta*, also simulate segments of clinal gradations, but field studies have shown that the siblings of each pair are strictly allopatric. In the last two and perhaps in other cases, no physical barriers separate the siblings, and preferred food-plants grow in the intervening areas. The isolation is strictly ecologic. Such allopatric forms are here considered species; this seems justified on ecological and historical grounds regardless of the genetic potential. The case of the Canadian *Alnus*-feeders, *a. alnicola*, *a. interna*, and *a. littorea*, is similar, except that they are separated by mountain barriers. The separation may not be absolute, but there is no evidence of clines. The three forms are separable only in series and then by size and colour only, but the differences are as great as those that distinguish some species. All three forms vary geographically. They are certainly distinct taxonomically. They may be specifically distinct, but their true status is unknown, and in this treatment they are presumed to be subspecies in the sense that well-characterized insular races are subspecies. The populations of *walshi* in southern and eastern Ontario differ somewhat in colour. Yet they have very much in common, and it is most improbable that they are specifically distinct. Similarly, adults of *a. alnicola* average darker than usual in Labrador and Alberta, and many of those of *falsa* are unusually pale at several localities. In other respects these populations are typical of the species to which they are assigned, and they appear to be geographic variants.

Small colonies showing restricted variation in colour of adults, as compared to large colonies in the same region, may occur in extremely variable species. Such colonies may differ somewhat from one another and apparently are established by single females that do not carry the total variability. Such colonies have been observed in *falsa*.

TAXONOMY AND NOMENCLATURE

Maulik (1925) has shown that the type species of *Chrysomela* L., 1758, is *Chrysomela populi* Fab. (= *C. populi* L.) and that *Chrysomela* L. must be used for the species that have been listed in *Lina* Redt., 1849 (= *Lina* of earlier authors), or in *Melasoma* Steph., 1831. Other synonyms of *Chrysomela* L., as now constituted, are *Microdera* Steph., 1834, *Macrolina* Mots., 1860, *Linaeidea* Mots., 1860, and *Strickerus* Lucas, 1920. The genera of the Chrysomelinae are

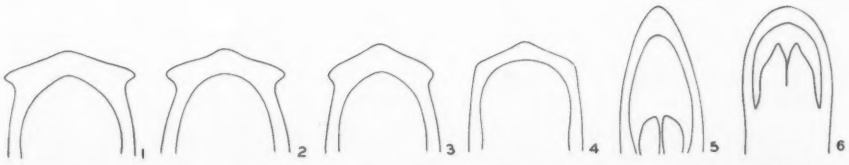
in need of much study, but the essential characters of *Chrysomela* appear to be as follows.

Body moderately to strongly convex. Antennae barely attaining the posterior pronotal angles. Pronotum with an impressed basal marginal line, which is sometimes feeble and interrupted; sulcate or subsulcate on each side in the New World species. Elytra with the punctures confused, or subseriate in part; each with a convex, impunctate ridge or interval along the lateral margin, the ridge sometimes feebly delimited; the epipleurae not descending strongly externally, lacking cilia on their internal margins. Mesosternum shorter than the intercoxal portion of the prosternum. Anterior coxal cavities broadly open behind; tibiae lacking dentiform processes; third segment of each tarsus deeply emarginate; tarsal claws divergent, not toothed.

In *Chrysolina* Mots. (= *Chrysomela* auctt.), which has been confused with *Chrysomela* L., the third segment of each tarsus is entire or feebly emarginate, and the internal margins of the elytral epipleurae are ciliate, often very indistinctly so, immediately before their apices. The larvae of the two genera differ strikingly; in *Chrysomela*, they are elongate and have a pair of tubercles, containing eversible glands, on the meso- and metathorax and on each of the first seven abdominal segments. In *Chrysolina* the larvae are very robust and lack tubercles and eversible glands. These and associated larval characters confirm the arrangement of Weise (1915), based on adult characters, which places the genera in different tribes (see also Chen, 1935, p. 138).

The generic characters require the reassignment of three New World species. *Chrysolina blaisdelli* Van Dyke and *Chrysolina engelhardti* Hatch belong to *Chrysomela*. *C. engelhardti* has been reared; its larvae are typical of *Chrysomela*, and, unlike those of *Chrysolina* which pupate in the soil, they pupate on the food-plant in the cast larval skin like those of *Chrysomela*. *Lina rubricollis* Philippi and Philippi (1864, p. 391), described from a specimen taken near Santiago, Chile, is represented in the F. C. Bowditch Collection, Museum of Comparative Zoology, Cambridge, Mass., by a single male from Valdivia, Chile. In this specimen each antenna surpasses the pronotal angle by the length of three segments, the pronotal sides are not sulcate, the elytral punctures are arranged in regular series, the mesosternum is elongate, the anterior coxal cavities are closed, and the tarsal claws are divaricate and obsoletely toothed; the species belongs to *Microtheca* Stål.

The New World species of *Chrysomela* are divided into three groups, the characters of which are given in couplets 1 and 3 of the following key. The two species of the *crotchi* group, and the two Old World species with which they have been confused, form a natural group of closely allied but readily separable species. The species of the *interrupta* group are sibling to one another, to the European species *lapponica* L., and to the closest Old World allies of the latter. Thus all of these form a natural group. *C. lapponica* has been described



Figs. 1-6. Apices of male copulatory organs of *Chrysomela* spp. 1, *C. saliceti* (Weise). 2, *C. tremula* Fab. 3, *C. crotchi* n. sp. 4, *C. invicta* n. sp. 5, *C. knabi* n. sp. 6, *C. scripta* Fab.

as an extremely variable species that feeds on *Salix*, *Populus*, *Alnus*, and *Betula;* it is virtually certain that *lapponica* of European authors is a complex of siblings. The *scripta* group is artificial, for *schaefferi* has no very close allies, and *blaisdelli* and *engelhardti* are closely allied only to one another. Without those species, the group is natural enough, for the others differ only in body form, sculpture, or colour, and the differences are very slight to moderate.

The sexes are readily separable. The apical abdominal segment is more broadly truncate in males. The females tend to be larger and usually have the elytral apices produced and more strongly acute. As noted in couplets 1 and 3 of the key, the genitalia of the males offer group characters. The internal sac lacks the armature found in some allied genera, and only in the *crotchi* group do the genitalia offer specific characters.

In *Chrysomela*, as in many other genera of the Chrysomelidae, the specimen of value is not a single insect but is, rather, a series of insects associated with one species of food-plant and from one locality or, preferably, one colony.

The synonymy and references given below with each description include: (1) all combinations that have been used for the species and the reference to the first usage of each; (2) all references giving descriptions; (3) to the limited extent noted above in the section on life-histories, references to habits.

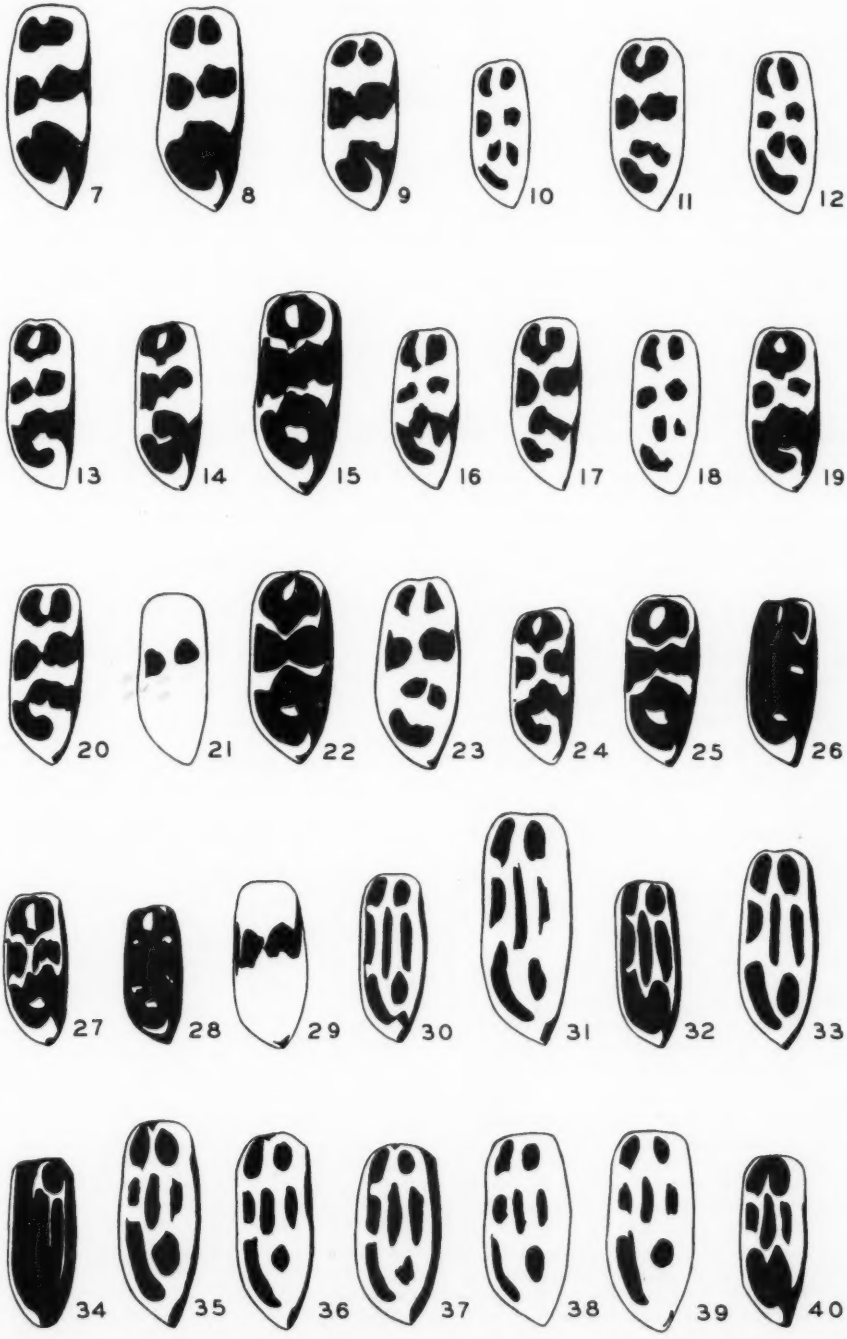
TAXONOMIC SUMMARY

The following summary gives for each New World species and subspecies of *Chrysomela*: (1) food-plants; (2) distribution; (3) the closely allied species with overlapping distributions, if any; (4) a note on characterization, with the species, if any, that are not or not always separable by the characters of museum specimens; and (5) a note on the variability of colour in adults. The term *sibling* is used in a very narrow sense to indicate one or more species that fall almost entirely in the range of variability of another species; in one sense all species and subspecies of the *interrupta* group are siblings as indicated in the notes on characterization.

crotchi group

1. *crotchi* n. sp.—Primarily *Populus tremuloides* Michx.; other species of *Populus*.
   Nova Scotia to northern Virginia, Idaho, Alberta, and central Alaska; New Mexico.
   Apparently allopatric to and readily separable from *invicta*.
   Variability moderate.
2. *invicta* n. sp.—Probably *Populus*.
   Southwestern Alberta and northwestern Montana.
   Apparently allopatric to and readily separable from *crotchi*.
   Variability moderate.

Figs. 7-40. Left elytra of *Chrysomela* spp. 7-9, *C. interrupta* Fab. (Durham, N.C.). 10, *C. alnicola alnicola* n. sp., s. str. (holotype; Constance Bay, Ont.). 11, *C. alnicola alnicola* n. sp., s. str. (Edmonton, Alta.). 12-13, *C. alnicola interna* n. subsp. (holotype and paratype; Cooper Landing, Alaska). 14-15, *C. alnicola littorea* n. subsp. (holotype and paratype; King Island, B.C.). 16-19, *C. walshi* n. sp. (holotype and paratypes; Arnprior, Ont.). 20-21, *C. knabi* n. sp. (holotype and paratype; Point Pelee, Ont.). 22, *C. knabi* n. sp. (Simcoe, Ont.). 23, *C. knabi* n. sp. (Irvine, Alta.). 24-26, *C. falsa* n. sp. (holotype and paratypes; Moose Pass, Alaska). 27, *C. aeneicollis* (Schaeff.) (topotype; Lake Louise, Alta.). 28-29, *C. aeneicollis* (Schaeff.) (Mount Apex, B.C.). 30, *C. scripta* Fab. (Leamington, Ont.). 31, *C. scripta* Fab. (Pelee Island, Ont.). 32-34, *C. laurentia* n. sp. (holotype and paratypes; Arnprior, Ont.). 35, *C. confluens* Rogers (Orinda, Calif.). 36, *C. semota* n. sp. (holotype; Norman Wells, N.W.T.). 37, *C. lineatopunctata* Forst. (West Point, N.Y.). 38, *C. lineatopunctata* Forst. (Lethbridge, Alta.). 39, *C. texana* (Schaeff.) (Hidalgo, Tex.). 40, *C. cruentipennis* (Duv.) (Laguna Ariguanabo, Cuba).


7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40

B & Z LIBRARY

interrupta group

3. *interrupta* Fab.—*Alnus serrulata* (Ait.) Willd.
Southeastern Pennsylvania to Georgia and Alabama.
Probably allopatric to all others of the group; possibly sympatric with *knabi*.
Usually well characterized, but some specimens inseparable from some of *knabi*.
Variability moderate.

4a. *alnicola alnicola* n. sp., s. str.—*Alnus* spp.; adults very rarely on *Salix* in early spring.
Newfoundland and the interior of Labrador to northern New Jersey, Alberta, and Great Slave Lake.
Sympatric with *walshi*, *knabi*, and *falsa*.
Sibling to *walshi;* some specimens inseparable from some of *a. interna* and *knabi*.
Variability moderate.

4b. *alnicola interna* n. subsp.—*Alnus* spp.; adults very rarely on *Salix* in early spring.
Inland regions, Oregon to south-central Alaska.
Sympatric with *falsa* and *aeneicollis*.
Sibling to *walshi* and *falsa;* some specimens inseparable from some of all others of the group except *interrupta* and *aeneicollis*.
Variability great.

4c. *alnicola littorea* n. subsp.—*Alnus oregona* Nutt.
Coasts of British Columbia and southernmost Alaska; probably southward on humid coasts.
Allopatric to all others of the group.
Some specimens inseparable from some of all others of the group except *interrupta* and *a. alnicola*.
Variability great.

5. *walshi* n. sp.—*Populus balsamifera* L.
Easternmost and southernmost Ontario; the Ottawa Valley in Quebec.
Sympatric with *a. alnicola* and *knabi*.
Sibling to *a. alnicola* and *a. interna;* some specimens inseparable from some of *a. littorea*, *knabi*, and *falsa*.
Variability great.

6. *knabi* n. sp.—*Salix* spp.; adults frequently on *Populus* spp. in the spring.
Southernmost Ontario, southernmost New Hampshire, and western North Carolina to southern Alberta and New Mexico.
Sympatric with *a. alnicola* and *walshi*, and possibly with *interrupta*.
Some specimens inseparable from some of all others of the group except *aeneicollis*.
Variability great.

7. *falsa* n. sp.—*Salix* spp. and *Populus* spp.
Newfoundland and northern Labrador to central Ontario, west-central British Columbia, and Alaska.
Sympatric with *a. alnicola* and *a. interna*, and possibly with *aeneicollis*.
Sibling to *a. interna;* some specimens inseparable from some of *a. littorea*, *walshi*, *knabi*, and *aeneicollis*.
Variability great.

8. *aeneicollis* (Schaeff.).—*Salix*.
Mountains of southern Alberta and British Columbia to southwestern Colorado and Tulare County, California.
Sympatric with *a. interna* and possibly with *falsa*.
Some specimens inseparable from some of *a. littorea* and *falsa*.
Variability moderately great.

scripta group

9. *scripta* Fab.—*Salix* spp. and *Populus* spp.
Southwestern Massachusetts and the shores of Lake Erie in Ontario to Florida, Mexico, eastern New Mexico and Utah, and southern British Columbia.
Sympatric with *lineatopunctata*, *texana*, and *schaefferi*.
Some specimens inseparable from some of *laurentia*.
Variability moderate.

10. *laurentia* n. sp.—*Salix* spp.; immature leaves and sucker growth of *Populus* spp.
James Bay to central New Hampshire, Lake Superior, and Great Slave Lake.
Sympatric with *lineatopunctata* and possibly with *semota* and *schaefferi*.
Some specimens inseparable from some of *scripta*.
Variability great.

11. *confluens* Rog.—*Salix* spp., possibly *Populus* spp.
Western Washington to central Utah and San Luis Obispo County, California.
Sympatric with *schaefferi*.
Some specimens inseparable from some of *semota*.
Variability great.

12. *semota* n. sp.—*Salix* and *Populus* spp.
Northwestern Montana to east-central British Columbia, the Mackenzie Valley, and Great Slave Lake.
Possibly sympatric with *laurentia*, *lineatopunctata*, and *schaefferi*.
Some specimens inseparable from some of *confluens*.
Variability slight.

13. *lineatopunctata* Forst.—*Salix* spp. and *Populus* spp.
Southernmost Quebec to northern New Jersey and Illinois, Colorado, central British Columbia, and northernmost Alberta.
Sympatric with *scripta*, *laurentia*, and *schaefferi*, and possibly with *semota*.
Well characterized.
Variability great.

14. *texana* (Schaeff.).—*Salix*.
Central and southern Texas.
Sympatric with *scripta*.
Well characterized.
Variability slight.

15. *mexicana* n. n. (*depressa* Suffr.).—Food-plant unknown.
Central Mexico to Guatemala and British Honduras.
Apparently allopatric to all others.
Well characterized.
Variability moderately great.

16. *cruentipennis* (Duv.).—*Salix*.
Western Cuba.
Allopatric to all others.
Well characterized.
Variability moderate.

17. *schaefferi* n. n. (*immaculata* Schaeff.).—*Salix*.
Northeastern Manitoba; east-central Alaska to the mountains of southwestern Alberta and to San Luis Obispo County, California.
Sympatric with *scripta*, *confluens*, and *lineatopunctata*, and possibly with *laurentia* and *semota*.
Well characterized.
Variability great.

18. *blaisdelli* (Van Dyke).—Food-plant unknown, probably *Salix*.
Western Alaska to the Mackenzie River and eastward.
Allopatric to all others except, possibly, *engelhardti*.
Well characterized.
Variability moderate.

19. *engelhardti* (Hatch).—*Salix*.
Mount McKinley National Park, Alaska; northwestern coast of Hudson Bay.
Allopatric to all others except, possibly, *blaisdelli*.
Well characterized.
Variability moderate.

KEY TO SPECIES AND SUBSPECIES

1. Elytra immaculate, pale brown or brownish yellow; pronotum with the sides not or scarcely paler than the disk; tibiae unicolourous. Usually larger; the males 7.0 to 8.0 mm., the females 7.2 to 9.7 mm. in length. Apex of male copulatory organ (Figs. 3-4) neither attenuate nor evenly rounded, angulate on each side (the *crotchi* group) 2

With the elytra maculate or entirely dark, or with the pronotal sides broadly pale and the disc dark, or with the tibiae distinctly bicoloured, or with the body smaller. Apex of male copulatory organ (Figs. 5-6) somewhat attenuate or broadly rounded, lacking lateral angles 3

2. Except for the elytra, darker; usually blackish, with strong green reflections and rufescent areas; the pronotum often rufescent laterally or throughout but rarely strongly so; body beneath usually reddish or rufescent in part; abdomen and legs nearly always largely or entirely dark. Elytral apices of the female distinctly produced, more strongly acute than in the male. Apex of male copulatory organ (Fig. 3) produced on each side into a blunt tooth. Northern Virginia and Nova Scotia to Idaho and Alaska; New Mexico ..... 1. *crotchi* n. sp.

Except for the elytra, paler; brownish-red, often with greenish reflections in certain lights, the metasternum and legs sometimes slightly darker in part. Elytral apices of the female not or scarcely produced, usually more strongly acute than in the male. Apex of male copulatory organ (Fig. 4) not produced on the sides. Southwestern Alberta and northwestern Montana ..... 2. *invicta* n. sp.

3. Each elytron (Figs. 7-29), when pale and maculate, with a basic pattern of seven dark spots of which *two* are median; these median spots never elongate, often joined together and to the suture to produce an irregular transverse band; the elytra sometimes largely dark due to fusion of the spots, the pale areas then reduced to small spots and, nearly always, very irregular transverse lines; the elytra very rarely entirely pale, sometimes with only the two median spots on each, usually with the spots more or less fused, never entirely dark; the pale ground of the elytra sometimes yellowish but always red in breeding individuals. Apex of male copulatory organ (Fig. 5) somewhat attenuate and rather narrowly rounded (the *interrupta* group). This group consists of eight sibling species and subspecies, which cannot be keyed. The following couplets give their food-plants and distributions. When two or more species occur in one locality, they breed on different hosts and are sometimes separable by colour 4

Each elytron (Figs. 30-40), when pale and maculate, with a basic pattern of seven dark spots of which *three* are median; these median spots always elongate, never joined to produce a transverse band; the elytra, when largely dark, with the pale areas reduced to longitudinal streaks; the elytra sometimes entirely pale (*schaefferi*), rarely with the median and posterior spots lacking in part, sometimes with the spots more or less fused, sometimes entirely blackish or bluish; the pale ground of the elytra pale red in *schaefferi*, reddish-yellow in *cruentipennis*, pale yellow in pinned specimens of other species, often silvery in breeding individuals. Apex of male copulatory organ (Fig. 6) broadly and evenly rounded (the *scripta* group) 11

4. Breeding on *Alnus;* the adults of *alnicola* very rarely on *Salix* in early spring 5
Breeding on *Salix* or *Populus* 8

5. Occurring east of the Rocky Mountains 6
Occurring in the Rocky Mountains and westward 7

6. Occurring from southeastern Pennsylvania to Georgia and Alabama. Larger; each elytron (Figs. 7-9) with the basal spots usually joined, the median spots often joined and nearly always attaining the suture, the posterior markings nearly always fused into a blotch which always attains the suture; underside and legs largely dark ..... 3. *interrupta* Fab.

Occurring from northern New Jersey, Newfoundland, and the interior of Labrador to Alberta and Great Slave Lake. Smaller; each elytron (Figs. 10-11) usually with seven discrete spots and with the suture entirely pale; underside and legs largely or entirely pale except in some specimens from Labrador ..... 4a. *alnicola alnicola* n. sp., s. str.

7. Occurring on the coasts of British Columbia and southernmost Alaska. Darker (Figs. 14-15); frequently with the pronotal sides largely or entirely dark and with the elytra largely dark; the underside and legs largely dark ..... 4c. *alnicola littorea* n. subsp.

Occurring in inland regions; Oregon to south-central Alaska. Paler above (Figs. 12-13) and sometimes beneath ..... 4b. *alnicola interna* n. subsp.

8. Restricted to *Populus balsamifera* L. Occurring in eastern and southernmost Ontario and in southwestern Quebec. Very variable (Figs. 16-19), but intermediate in colour and size between *a. alnicola* and *knabi* ..... 5. *walshi* n. sp.
Sometimes occurring on, but not restricted to, *Populus* 9

9. Breeding on both *Populus* and *Salix*. Northern, occurring from Newfoundland and Labrador to British Columbia and Alaska. Extremely variable in colour (Figs. 24-26) ..... 7. *falsa* n. sp.
Breeding only on *Salix;* the adults of *knabi* frequently on *Populus* in the spring 10

10. Occurring in the mountains of southern Alberta and southern British Columbia to southwestern Colorado and Tulare Co., California. Smaller; pronotum entirely dark or virtually so, the dark areas of the elytra (Figs. 27-29) usually covering more than half of the disk ..... 8. *aeneicollis* (Schaeff.).
Occurring from southernmost Ontario, southernmost New Hampshire, and western North Carolina to southern Alberta and New Mexico. Larger; the pronotal sides broadly pale, the dark areas of the elytra (Figs. 20-23) less extensive ..... 6. *knabi* n. sp.

11. Elytra without traces of striae except for the stria (obsolete in *schaefferi*) that limits the external ridge of each; the punctures not arranged in series except near the suture 12
Elytra distinctly substriate; occasionally with the punctures confused as in the other species and with the intervals subequal; usually with the discal punctures subseriate in part and with the third, fifth, and seventh intervals largely impunctate and more convex; the elytra entirely blackish. Arctic species 20

12. Body elongate, the width from 50 to 55 per cent as great as the length; the standard elytral pattern of dark spots well defined except rarely in *laurentia;* the three median spots of each elytron very elongate, the intermediate of these usually from six to seven times as long as wide (Figs. 30-34) 13
Body usually less elongate, the width at least 53 per cent as great as the length; elytra largely or entirely dark, or with the median spots shorter and with the intermediate of these very rarely more than five times as long as wide (Figs. 35-40) 14

13. Usually larger; the elytral spots usually relatively smaller, discrete or virtually so (Figs. 30-31). More southern; southern New England, southernmost Ontario, and the southern parts of the Prairie Provinces and British Columbia to southernmost United States and Mexico ..... 9. *scripta* Fab.
Usually smaller and with the dark areas of the elytra more extensive; the elytral spots sometimes more or less confluent (Figs. 32-34). More northern; south-central Quebec and central New England to eastern Ontario, Lake Superior, and Great Slave Lake ..... 10. *laurentia* n. sp.

14. Restricted to Cuba. Elytral spots blue-green, forming the standard pattern, the posterior pair of each elytron nearly always joined together to produce a blotch that is emarginate anteriorly (Fig. 40) ..... 16. *cruentipennis* (Duv.)
Restricted to continental North America 15

15. Pronotum entirely reddish-brown; elytra reddish-brown or with reddish-brown spots forming the standard pattern on a paler ground. Sublateral sulci of the pronotum feebly impressed or obsolete; the entire dorsum more closely and coarsely punctate than in any other species. Central Mexico and southward . 15. *mexicana* n. n.
Pronotum usually bicoloured or entirely blackish; when entirely reddish, the elytra with blackish spots. Pronotal sulci more strongly impressed 16

16. Elytra entirely pale, or entirely blackish and somewhat bronzed; never with bluish reflections. Length not greater than 6.5 mm. Lateral ridge of each elytron feebly delimited. Western ..... 17. *schaefferi* n. n.
Elytra with the standard pattern of dark spots, or entirely dark blue or blue-green, or dark and with the lateral margins or some discal spots pale (rarely obscurely pale in *lineatopunctata*). Lateral ridge of each elytron strongly delimited 17

17. Head, pronotum, underside, and legs entirely reddish-yellow or virtually so. Central and southern Texas (Fig. 39) ..... 14. *texana* (Schaeff.)
Head, pronotum, underside, and legs dark or bicoloured except in some specimens of the more northern species *lineatopunctata* 18

18. Body more convex and less elongate, the width from 57 to 59 per cent as great as the length. Extremely variable in colour (Figs. 37-38) ..... 13. *lineatopunctata* Forst.
Body slightly less convex and slightly more elongate, the width 54 to 58 per cent as great as the length. Western species 19

19. Elytra virtually dichromatic; either entirely deep blue or blue-green, or pale and maculate with the standard pattern (Fig. 35), the intermediate condition very rare; the spots usually bluish, sometimes blackish, rarely confluent. More southern; western Washington to central Utah and central California 11. *confluens* Rog.
Elytra always maculate with the standard pattern (Fig. 36); the markings always blackish, virtually always discrete. More northern; northwestern Montana, southeastern British Columbia, and northward ..... 12. *semota* n. sp.

20. Pronotum bicoloured, the sides broadly red ..... 18. *blaisdelli* (Van Dyke)
Pronotum entirely black ..... 19. *engelhardti* (Hatch)

DESCRIPTIONS OF SPECIES AND SUBSPECIES

1. *Chrysomela crotchi* n. sp.

Plagiodera tremulae, Crotch, 1873, p. 53; Riley, 1880, p. 160.
Lina tremulae, Henshaw, 1885, p. 110; Lugger, 1889, p. 55, Fig. 5; Blatchley, 1910, p. 1161; Essig, 1926, p. 472; Schaeffer, 1928, p. 45.
Melasoma tremulae, Hamilton, 1894, p. 398 (in part); Felt, 1906, p. 565, Fig. 141; Weise, 1916, p. 146 (in part).
Chrysomela tremulae, Wilcox, 1954, p. 421.
Melasoma saleceti Reit. (in error for, but not *M. saliceti* Weise), Schaeffer, 1920, p. 330.
Lina saliceti, Chagnon, 1938a, p. 17, 1938b, p. 305.

Adult.—Length of males, 7.0 to 8.0 mm.; of females, 7.5 to 9.7 mm. Elytra pale brown or brownish-yellow, immaculate; the other appendages and body dark, usually blackish and with dark green reflections and rufescent areas; the pronotum usually more or less rufescent, sometimes only on the sides, sometimes throughout. Beneath, the intercoxal portion of the first abdominal segment and the thoracic sclerites nearly always rufescent in part at least, often very strongly so; the sides of the apical ventral segment always pale. Paler specimens with the bases of the antennae and femora rufescent; the palest specimen with the head, pronotum, and thorax beneath reddish-brown as in *invicta* but with the abdomen and legs darker than in that species.

Pronotal sides variable, sometimes almost straight, usually straight or feebly sinuate before the base and feebly to moderately arcuate at middle and anteriorly. Elytral apices of the female distinctly produced, more strongly acute than in the male, the sexes readily separable by this character. First segment of each tarsus slightly narrower than the third in both sexes, the fifth segment of each lacking processes beneath the claws.

Apex of male copulatory organ (Fig. 3) produced at middle and produced into a blunt tooth on each side.

Geographic variation.—In the nine specimens from Jemez Springs, N. Mex., in eight of the ten from Lorain Co., Ohio, and in fourteen of the fifteen from New Brunswick, rufescence is lacking on the pronotum and is lacking or obsolete on the body beneath. Thus these series are darker than the others, which are from Ontario and Manitoba.

Food-plants.—The primary food-plant is *Populus tremuloides* Michx., but adults and larvae are found on *P. balsamifera* L. and *P. grandidentata* Michx. Under the name *tremulae*, Lugger (1889, p. 55), Felt (1906, p. 565), Davis (1920, p. 145), and others have reported beetles presumably of this species from *Salix*.

Distribution.—Northern Virginia, New England, and Nova Scotia to Idaho, Alberta, and central Alaska; New Mexico. The specimens seen are from:—

Nova Scotia: Alton, Queens Co. (*P. grandidentata*, reared from larvae).
New Brunswick: Halcomb, Tobique River (poplar), Bryenton (poplar).
Quebec: Berthierville.
Ontario: Chalk River (*P. tremuloides*), Delhi (*P. tremuloides*, *P. balsamifera*), DeCew Falls, Fort Francis, Geraldton (*P. tremuloides*), Graham (poplar), Hurkett (poplar), Ignace (poplar), Macdiarmid (poplar), 10 miles west of Nakina (*P. tremuloides*), Point Pelee, Port Arthur (*P. tremuloides*), Port Colborne, Port Rowan, Prince Edward Co., Roseland, South Cayuga, Tecumseh, Toronto, Turkey Point (*P. tremuloides*), Walsingham (*P. tremuloides*).
Manitoba: Arnaud (aspen), Aweme, Berens River (*P. tremuloides*), Brandon, Carberry (aspen), Cedar Lake, Haywood (aspen), Husavick, Norway House (*P. tremuloides*), Riding Mountain National Park (*P. tremuloides*), Treesbank.
Saskatchewan: Bredenbury, Christopher Lake (*Populus*), Harris, Saltcoats, Unity, Welby, Yorkton.
Alberta: Cypress Hills, Edgerton Station, Elkwater, Lac la Biche, Medicine Hat.

NORTHWEST TERRITORIES: Fort Smith (*P. tremuloides*), Norman Wells (*P. tremuloides*).
ALASKA: College (*P. tremuloides*), Fort Yukon.
MAINE: Norway, Paris, Sebago Lake.
NEW HAMPSHIRE: Durham, Franconia, Mount Washington, Randolph, Rumney, Three Mile Id.
MASSACHUSETTS: Berlin, Marion, Mount Tom, Needham, Petersham, Southboro, Springfield, Tyngsboro, West Boylston.
CONNECTICUT: Winsted.
NEW YORK: Axton, Horicon, West Point.
NEW JERSEY: Dundee Lake.
PENNSYLVANIA: Allegheny National Forest, Broomall, Castle Rock, Kane (aspen), Lehigh Gap, Lopez, Montgomery Co., North East (poplar), Philadelphia, Pocono Lake, Warren (aspen).
DELAWARE: Wilmington.
MARYLAND: Beltsville, Lanham, Wolfville.
VIRGINIA: Falls Church, Four Mile Run, Glencarlyn.
WEST VIRGINIA: Tucker Co.
OHIO: Lorain Co. (*P. tremuloides*).
MICHIGAN: Eagle River, Escanaba, Marquette.
ILLINOIS: Lisle.
WISCONSIN: Bayfield.
MINNESOTA: Ely (poplar).
SOUTH DAKOTA: Custer (aspen), Sheridan.
WYOMING: Douglas, Grand Teton National Park.
NEW MEXICO: Jemez Springs.
IDAHO: Victor.

Holotype, ♂; *allotype*, ♀; 16 ♂ and 21 ♀ *paratypes*.–Riding Mountain National Park, Manitoba, June 9, 1937 (W. J. Brown), on *Populus tremuloides* Michx.; No. 6155 in the Canadian National Collection, Ottawa.

Notes.–In the European *tremula* Fab., 1787 (= *tremulae* Fab., 1801, and subsequent authors), and *saliceti* (Ws.), with which *crotchi* has been confused, the body lacks rufescent areas, and the apex. of the male copulatory organ (Figs. 1-2) is more strongly produced on each side. In *tremula* the fifth segment of each tarsus is produced into a small, very acute angle beneath each claw; in the male the first segment of each tarsus is virtually as wide as the third; and the elytral apices are not modified in the female. In *saliceti* the pronotal sides are usually more evenly arcuate, the elytral apices are less strongly modified in the female, and the apex of the male copulatory organ (Fig. 1) is almost evenly rounded.

C. crotchi frequently defoliates *Populus tremuloides* in Saskatchewan and Manitoba, but it is rare in eastern regions.

2. *Chrysomela invicta* n. sp.

Adult.–Length of males, 7.0 to 7.2 mm.; of females, 7.2 to 9.0 mm. Elytra brownish-yellow, immaculate; the other appendages and body brownish-red, sometimes with greenish reflections in certain lights; the metasternum and legs sometimes slightly darker in part; the apical halves of the antennae darker.

Pronotal sides variable, almost straight before the base and sometimes also at middle, moderately arcuate before the anterior angles and usually feebly so at middle. Elytral apices of the female not or scarcely produced, usually more strongly acute than in the male. First segment of each tarsus slightly narrower than the third in both sexes, the fifth segment of each lacking processes beneath the claws.

Apex of male copulatory organ (Fig. 4) prominent at middle, not produced on the sides.

Food-plant.–Probably *Populus*.

Distribution.—Known only from southwestern Alberta and northwestern Montana.

Holotype, ♂, and *allotype*, ♀.—Waterton, Alberta, July 1, 1924 (H. L. Seamans); No. 6156 in the Canadian National Collection, Ottawa. *Paratypes.*—1 ♂, 6 ♀, same locality and collector, June 30 and July 1, 1924; 1 ♀, same locality, June 27, 1929 (J. H. Pepper); 4 ♂, 7 ♀, Pincher Creek, Alberta, May 22, 1926, and July 15, 1929 (F. S. Carr); 2 ♀, South Fork of the Old Man River, Alberta, May 24, 1928 (F. S. Carr), on balsam poplar; 2 ♂, 6 ♀, Kalispell, Montana, June 13-20 (H. F. Wickham), in the U.S. National Museum and the Museum of Comparative Zoology.

Note.—The species seems to differ from *crotchi* only by the characters given in the key.

3. *Chrysomela interrupta* Fabricius

Chrysomela interrupta Fabricius, 1801, p. 438 [cotypes: Carolina; probably lost (Blake, 1952, p. 66)]; Olivier, 1807, p. 558, Pl. 8, Fig. 119; Rogers, 1856, p. 37 (in part); Suffrian, 1858, p. 388 (in part).
Melasoma interrupta, Melsheimer, 1853, p. 124.
Plagiodera interrupta, Stål, 1865, p. 293 (in part).
Lina interrupta, Hamilton, 1889, p. 148 (as a synonym of *Chrysomela lapponica* Linnaeus, 1758).
Melasoma lapponica interrupta, Weise, 1916, p. 142 (in part).
Melasoma Alni (F. V. Melsheimer MS.) F. E. Melsheimer, 1853, p. 124 (*nomen nudum* cited in synonymy).
Plagiodera lapponica, Crotch, 1873, p. 53 (in part).
Lina lapponica, Henshaw, 1885, p. 110.
Melasoma interrupta discicollis (LeConte MS.) Gemminger and Harold, 1874, p. 3411 (*nomen nudum* cited in synonymy).
Melasoma 12-notata (Chevrolat MS.) Gemminger and Harold, 1874, p. 3411 (*nomen nudum* cited in synonymy).
Melasoma 4-punctata (Knoch MS.) Gemminger and Harold, 1874, p. 3411 (*nomen nudum* cited in synonymy).

Adult.—Length of males, 6.0 to 7.3 mm.; of females, 6.9 to 8.0 mm. The dark parts with distinct blue or blue-green reflections. Head entirely dark; each antenna with the basal segment and four or five apical segments dark. Pronotum with the area between the sulci entirely dark; pale externally except for a median spot on each side; the spot nearly always broadly attached to the dark discal area, very rarely expanded to cover up to one-third of the lateral area.

Elytra (Figs. 7-9) pale; with large basal, median, and posterior dark markings. The basal markings of each consisting of two spots which are usually broadly joined; the spots never much longer than wide, the outer never lunate, the inner never attaining the suture; when narrowly joined, the pale intrusion rarely elongate; the spots never joined to enclose completely a pale area. The median markings of two spots which are joined, often broadly so, in about half of the specimens; the inner spot usually attaining the suture and prolonged anteriorly along it. The posterior markings consisting of a fused postmedian pair and a subapical spot, which are usually broadly joined to produce a single large blotch that is prolonged along the suture to the apex; the subapical spot rarely narrowly joined or free; the sutural interval, between the median and posterior markings, usually dark.

Body beneath dark, with the prothoracic sides broadly and the abdominal sides, on the two apical segments at least, narrowly pale; intercoxal parts of metasternum and first abdominal segment sometimes rufescent. Femora dark; tibiae pale except at their extreme bases, their apical portions more or less infuscate; tarsi brown.

Immature stages.—Unknown.

Geographic variation.—None observed.

Food-plant.—*Alnus serrulata* (Ait.) Willd. (*rugosa* of many authors).

Distribution.—Southeastern Pennsylvania to Georgia and Alabama. The specimens studied are from:—

PENNSYLVANIA: Clarks Valley (near Harrisburg).
MARYLAND: Glen Echo, Piney Point, Tall Timbers.
DISTRICT OF COLUMBIA (*Alnus*).
VIRGINIA: Cape Charles, Charlottsville (alder), Deep Creek, Fort Monroe, Great Falls (alder), Norfolk, Vienna (*Alnus*).
WEST VIRGINIA: White Sulphur Springs.
NORTH CAROLINA: Clayton, Durham (*A. rugosa*), Holly Shelter (*Alnus*), McDowell Co. (*Alnus*), Raleigh (*A. rugosa*), Southern Pines, Swannanoa Valley.
SOUTH CAROLINA: Aiken, Batesburg, Clemson, Greenville Co., Isle of Palms, Jocasse, Mountain Rest, Rocky Bottom, Russells, Salem, Walhalla.
GEORGIA: Athens, Blairsville, Clayton, Cloudland Canyon State Park, Fort Valley, Milner (*Alnus*), Satolah.
ALABAMA: Langdale.

Notes.—The elytral markings are usually distinctive. In *knabi* (Figs. 20-23) and other species that approach *interrupta* in colour, the humeral spot is usually elongate and arcuate, and an elongate pale spot is enclosed, partially or entirely, when the two basal spots are joined; the median markings are closer to both the basal and posterior markings; and the posterior markings are very rarely fused into a solid blotch. The form with quadrimaculate elytra has not been observed in *interrupta*.

In his description of *interrupta*, Fabricius stated that the dark parts, including the elytral spots, were blue and that the basal and median elytral spots often formed fasciae. His description, like the description and figure of Olivier which may have been based on type material, agrees with the alder-feeding species of the Southeast rather than with the willow-feeding *knabi*, which occurs in the extreme western part of North Carolina. Fabricius stated that *interrupta* occurred on willow, but it seems reasonable to assume that this statement is in error.

4a. *Chrysomela alnicola alnicola* n. sp., s. str.

Chrysomela interrupta, in the sense (in part) of: Rogers, 1856, p. 37; Suffrian, 1858, p. 388; Beller and Hatch, 1932, p. 97; Wilcox, 1954, p. 421.
Melasoma interruptum Hald. (in error for, but not *Chrysomela interrupta* Fabricius, 1801), Cushman, 1917, p. 128.
Lina interrupta, Chagnon, 1938a, p. 17; 1938b, p. 305; in the sense (in part) of Schaeffer, 1928, p. 42.

Adult.—Length of males, 4.8 to 6.0 mm.; of females, 5.8 to 7.1 mm. Dark parts of head and pronotum with greenish reflections. Head entirely dark or with a pale spot at the base of each antenna; each antenna often entirely pale, often with the basal segment and as many as five apical segments infuscate. Area between the pronotal sulci usually entirely dark or with a pale or rufescent area on each side anteriorly, sometimes with more extensive rufescent areas, rarely almost entirely pale; the pronotum externally entirely pale or with a median spot, usually obsolete and never large, on each side.

Elytra (Figs. 10-11) pale; each usually with seven discrete spots; the spots of the basal pair rarely joined apically and very rarely basally; very rarely, the median spots joined or obsolete; the postmedian spots occasionally joined, rarely obsolete; the subapical spot nearly always free; the suture nearly always entirely pale; the elytra very rarely quadrimaculate or with all spots obscure.

Body beneath usually largely or entirely pale, rarely almost entirely dark. Legs entirely pale or, rarely, with the femora more or less darkened and the tarsi brownish.

Immature stages (observed in the Ottawa district and at Gander, Nfld.).—Eggs varying from white to very pale yellow. Larvae dichromatic in the third instar.

Geographic variation.—This concerns the colour of the adults and of the larvae of the third instar. Of the eleven series compared, adults from Edmonton, Alta., and Goose Bay, Labr., are the darkest. The elytral spots of one or more pairs are joined in 50 of the 67 specimens from Edmonton and in 14 of the 34 from Goose Bay. In the other series the spots are usually discrete, rarely or infrequently joined, as noted in the description above. Of the Goose Bay specimens, 14 have the body beneath and femora almost entirely black, and the body beneath in 12 others is more or less darkened. In the other series only two specimens from Edmonton, two of 69 from Gander, Nfld., and two of 197 from the Ottawa district have the femora darkened. In the Edmonton series the body beneath is about half pale to largely pale in most specimens but is dark in part in all. The body beneath, although nearly always almost entirely pale, is dark or infuscate in part in 76.1 per cent of the 109 specimens of the type series; in 81.8, 86.2, and 88.4 per cent respectively of the 88 specimens from Marmora and Arnprior, Ont., and Quyon, Que., which are near the type locality; in 58.8 per cent of 68 from Brome, southernmost Quebec; in 41.1 per cent of 34 from Norway House, central Manitoba; in 15.9 per cent of 69 from Gander, Nfld.; in one specimen of 31 from Fonthill, southernmost Ontario; and in 20.0 per cent of 30 specimens from Dolgeville, central New York. Small series from other Albertan localities agree well with those from Edmonton. Two of the five specimens from Great Slave Lake have quadrimaculate elytra; they are the only known examples of this form.

Counts of larvae in the third instar show the number belonging to the pale form to be 23.2 per cent of 306 larvae from the type locality, 68.5 per cent of 35 from Gander, and 75.8 per cent of 58 from Edmonton. Larvae have been observed also at Goose Bay and in all parts of the Ottawa district; apparently they are always dichromatic. All egg masses from which mature larvae were reared produced larvae of both the pale and dark forms.

Food relationships.—The food-plants are *Alnus rugosa* (Du Roi) Spreng. (*incana* of American authors) and *A. temuifolia* Nutt. On one occasion when the species was emerging from hibernation there, four specimens, surely of *a. alnicola*, were taken from *Salix* at Marmora, Ont. Perhaps *a. alnicola* feeds sparingly and infrequently on *Salix* at that time.

Newly hatched larvae from the Ottawa district were tested in the laboratory. Of 129 larvae from nine egg masses given *A. rugosa*, 86.0 per cent attained the adult state. In all cultures given *Populus balsamifera*, 490 larvae from 33 egg masses, the larvae fed sparingly for a few hours and died, usually within three days, without moulting. Cultures given *Salix fragilis* fed normally and suffered little or no mortality. Larvae reared on *S. fragilis* always matured more slowly than those reared on *A. rugosa*. When three hatching masses were divided, the lots, comprising 24 specimens, reared on *S. fragilis* required 10.0, 11.4, and 12.3 per cent longer to attain the adult state than the lots, 32 specimens, reared on *A. rugosa*. All adults from larvae reared on *S. fragilis* appeared to be normal.

Newly hatched larvae from Gander, Nfld., were tested. Larvae from one egg mass, given *A. rugosa*, matured without mortality. Given *A. crispa* (Ait.) Pursh, 183 larvae from seven egg masses seemed to find the leaves too hard;

they persisted at feeding but died in the first or, rarely, in the second instar. On *Salix discolor* Muhl., 495 larvae from 18 masses fed erratically and died in the first or, rarely, in the second instar.

Distribution.—Northern New Jersey, Nova Scotia, Newfoundland, and the interior of Labrador to Alberta and Great Slave Lake. The specimens seen are from:—

NEWFOUNDLAND: Gander (*A. rugosa*).
LABRADOR: Goose Bay (*Alnus*).
NOVA SCOTIA: Boisdale, Cow Bay (*A. rugosa*), Mount Uniacke (*A. rugosa*), Newport (*A. rugosa*).
NEW BRUNSWICK: Shediac (*A. incana*).
QUEBEC: Alcove (*A. incana*), Brome (*A. incana*), Chelsea (*A. incana*), Hudson, Hull (*Alnus*), Quyon (*A. incana*), Rimouski (*A. incana*), Wakefield.
ONTARIO: Arnprior (*A. incana*), Biscotasing (alder), Blackburn (*A. incana*), Chapleau (alder), Constance Bay (*A. incana*), Elsas (alder), Foleyet (alder), Fonthill (*Alnus*), Franz (alder), Gogama (alder), Hope Bay (alder), Hurkett (alder), Lappe (alder), Marmora (*A. rugosa, Salix*), Matawatchan (alder), Mattagami (alder), Mattice (alder), Nairn Centre (alder), Ottawa (*A. incana*), Peterbell (alder), Roebuck (alder), Sault Ste. Marie (alder), Severn Park (alder), Swastika (alder), Timmins (alder), White River (alder).
MANITOBA: Norway House (*A. incana*), Riding Mountains, The Pas.
ALBERTA: Blackfalds (*Alnus*), Cold Lake (alder), Colinton (alder), Conklin (alder), Edmonton (*A. tenuifolia*), Lac la Biche (*A. tenuifolia*), Plamodon (alder).
NORTHWEST TERRITORIES: Et-then Island of Great Slave Lake (*Alnus*), Fort Resolution, Fort Smith.
MAINE: Milford, Mount Desert, Sebago Lake.
NEW HAMPSHIRE: Durham, Hampton Beach, Hudson, Lyme (*A. incana*), Pinkham Notch.
VERMONT: Brattleboro.
MASSACHUSETTS: Brookline, Chicopee, Dover, Framingham (*A. incana*), Holyoke, Monterey (*A. incana*), Montgomery, Nahant, Newton, Sherborn, Springfield, Paxton, Tyngsboro, Wellesley.
CONNECTICUT: Cornwall.
NEW YORK: Dolgeville (*A. incana*), Pike, Rochester (*A. incana*), West Point.
PENNSYLVANIA: Effort, Mount Pocono (alder), North East (alder).
NEW JERSEY: Newark.
MICHIGAN: Douglas Lake (near Pellston).

Holotype, ♂; *allotype*, ♀; 52 ♂ and 55 ♀ *paratypes*.—Constance Bay (near Ottawa), Ontario, May 13 and July 10, 1941 (W. J. Brown), on *Alnus rugosa* (Du Roi) Spreng.; No. 6157 in the Canadian National Collection, Ottawa. The types are from a single colony.

Notes.—C. *a. alnicola* is separable from *walshi* only in series but is readily distinguished when it occurs with *knabi* or *falsa*, which are much darker both above and beneath except when the elytra are quadrimaculate and in Labrador, where some specimens of *a. alnicola* are as dark beneath as average specimens of *falsa*. Compared to extra-limital forms, some specimens of *a. alnicola* resemble the palest examples of *a. interna*, and many specimens of the former from Labrador resemble small examples of the lightly maculate western form of *knabi* or of *a. interna* from central British Columbia.

4b. *Chrysomela alnicola interna* n. subsp.

Chrysomela interrupta, in the sense (in part) of Rogers, 1856, p. 37, and of Suffrian, 1858, p. 388; Beller and Hatch, 1932, p. 97 (in part).
Plagiodera interrupta, in the sense (in part) of Stål, 1865, p. 293.
Lina interrupta, in the sense (in part) of Schaeffer, 1928, p. 42.
Plagiodera lapponica, in the sense (in part) of Crotch, 1873, p. 53.

Adult.—Length of males, 5.5 to 6.5 mm.; of females, 6.5 to 7.8 mm. Head, dark parts of the pronotum, and sometimes the spots of the elytra with greenish reflections. Elytra (Figs. 12-13) pale; each frequently with seven discrete spots but with the spots of one or more pairs joined in about two-thirds of the

specimens; each frequently with the spots of the basal pair joined apically, basally, or at both ends; the median spots nearly always free; the postmedian frequently joined together and frequently joined to the subapical spot; the suture usually entirely pale, rarely entirely dark. Colour of the other parts varying geographically.

Immature stages (from Cooper Landing, Alaska, and Lavington, B.C.).—Eggs whitish or pale yellow, rarely (Cooper Landing) deep yellow. Larvae dichromatic in the third instar, usually pale, rarely dark.

Geographic variation.—In northern adults the parts except for the elytra are darker, and the elytra are sometimes quadrimaculate.

Type series (93 specimens from Cooper Landing, Alaska).—Antennae with segments two to five or six largely or entirely pale, the other segments blackish. Pronotum with the area between the sulci entirely dark; pale externally except for the median spot on each side; the spots always present, nearly always attached to the discal area, strongly expanded in one specimen and expanded to cloud the entire lateral areas except at the angles in another. Elytra quadrimaculate in 19 specimens. Body beneath, except for the sides of the prothorax, blackish; the sides of the two terminal abdominal segments and usually the apex of the apical segment very narrowly pale; the intercoxal areas, the abdominal sutures, or the disk of the apical segment occasionally pale or rufescent. Femora and tarsi dark except, usually, for the extreme bases of the former; the tibiae often entirely pale or virtually so, often darkened apically and at their extreme bases.

A pale series (27 specimens from Lavington, southernmost-central British Columbia).—Antennae usually entirely pale except for three or four apical segments. Pronotum with the pale areas invading the disk apically in ten of the specimens; the lateral spots frequently free, frequently obsolete, never expanded. Elytra as described above. Body beneath as dark as in the types in one specimen, about half pale to largely pale in most specimens but partly dark in all. Legs entirely pale, the femora largely dark in one specimen.

Other series.—Thirty specimens from Lillooet and Steelhead, southernmost British Columbia, and 24 from Mt. Rainier, Wash., match the Lavington series, which is described above. In 130 specimens from Taltapin Lake, central British Columbia at latitude 54°, and in eight from the Kitimat River, to the west of that lake, the colour dorsally is typical enough, but the underside and legs average paler than in the types; the series are intermediate between the pale, southern series and the Alaskan types. No specimens have quadrimaculate elytra except some of the types and one from Taltapin Lake.

Food relationships.—The food-plants are *Alnus tenuifolia* Nutt. and *A. oregona* Nutt. (= *rubra* Bong.). Several specimens were taken at Lavington, B.C., from *Salix* sp. that was interspersed with infested *A. tenuifolia;* rearing at Ottawa failed to establish any difference between the progeny of these and of specimens from the *Alnus*. At Cooper Landing, Alaska, adults confined for 24 hours on *A. sinuata* (E. Regel) Rydb. did not attempt to feed; adults confined on *Populus trichocarpa* fed freely.

Newly hatched larvae survived as well on *Alnus rugosa*, *Populus trichocarpa*, and *Salix fragilis* as on *A. tenuifolia*. At Cooper Landing, 78 adults, which appeared normal, were obtained from 84 larvae reared on *P. trichocarpa*. Adults from Lavington, confined on *A. rugosa* at Ottawa, lived and laid normally and produced larvae that survived similarly on that plant and on *S. fragilis*; these larvae matured at the same rate on both plants.

Distribution.—Inland regions, Oregon to south-central Alaska. The specimens seen are from:—

ALASKA: Cooper Landing (*A. tenuifolia*).
BRITISH COLUMBIA: Aleza Lake (*Alnus*), Indian River, Kitimat River (*Alnus*), Lavington (*A. tenuifolia, Salix*), Leanchoil (*Alnus*), Lillooet (reared from larvae on *Alnus*), Ptarmigan Creek (*Alnus*), Shuswap Falls, Steelhead (*A. rubra*), Taltapin Lake (*Alnus*), Vernon.
WASHINGTON: Longmire, Mount Rainier (*A. rubra*).
OREGON: 13 miles east of Cascadia (alder).

Holotype, ♂; *allotype*, ♀; 43 ♂ and 48 ♀ *paratypes*.—Cooper Landing, interior of the Kenai Peninsula, Alaska; June and August, 1951 (W. J. Brown); collected as adults, or as eggs or larvae and reared, from *Alnus tenuifolia* Nutt.; No. 6158 in the Canadian National Collection, Ottawa. The types are from a single colony.

Notes.—*C. a. interna* is apparently a well-defined subspecies that darkens progressively from south to north. It averages larger and considerably darker than *a. alnicola*. Adults are not separable from lightly maculate specimens of *falsa* but will not be confused with the much darker *aeneicollis*. Compared to the extralimital forms of the *interrupta* group, specimens or entire populations of *a. interna* are scarcely separable from some specimens or populations of all except *interrupta*.

4c. *Chrysomela alnicola littorea* n. subsp.

Lina scripta Linn. (in error for, but not *Chrysomela scripta* Fabricius, 1801), Leng. 1919, p. 17.

Adult.—Length of males, 6.0 to 6.9 mm.; of females, 7.1 to 8.0 mm. Head and the dark parts of the pronotum and, usually, of the elytra distinctly green or blue-green. Head entirely dark; antennae with segments two to five or six largely or entirely pale, the other segments blackish. Elytra (Figs. 14-15) fully maculate in all specimens.

Immature stages (from the Sarita River, Vancouver Island).—Eggs whitish or very pale yellow. Larvae not dichromatic, always blackish.

Geographic variation.—The adults become darker to the north.

Type series (18 specimens from King Island, coast of British Columbia at latitude 52°).—Pronotum entirely dark in eight specimens; each lateral spot expanded in eight others to cover most of the lateral area. Elytra (Fig. 14-15) with the dark spots expanded to cover half or more of the disk; each with the basal spots joined apically, basally, or at both ends in all specimens; the median spots joined in all but two; the postmedian usually joined together and to the subapical spot; the suture entirely dark in ten, partly dark in the others; the darkest specimen with the elytra entirely dark except for the outer margins very narrowly and eight small spots. Body beneath entirely dark except for the lateral margins of one or two terminal segments and, in ten specimens, the lateral margins or angles of the prothorax. Legs usually entirely dark except for rufescent areas on the tibiae; the tibiae largely pale in three specimens; the tarsi pale in one.

Pale series (35 specimens from four localities on southern Vancouver Island).—Pronotum with the lateral areas largely or, except for the spot on each, entirely pale; the spots infrequently small and free, infrequently expanded to cover as much as one-quarter of the lateral areas. Elytra with the dark areas averaging slightly smaller than in the types; the spots of each basal pair infrequently free. Body beneath with the pronotal sides broadly and the sides of two or three abdominal segments narrowly pale; the intercoxal parts some-

times pale or rufescent. Femora blackish; tibiae bicoloured or virtually entirely pale; tarsi usually brownish, infrequently pale.

Other series.–Short series from Ketchikan, southernmost Alaska, and from Rivers Inlet and Glendale Cove, at latitudes 51° and 50° on the coast of the British Columbian mainland, agree with the types.

Food relationships.–The food-plant is *Alnus oregona* Nutt. (= *rubra* Bong.). Adults from Sarita River, Vancouver Island, lived and laid normally when confined at Ottawa on *Alnus rugosa* and produced larvae that survived well on that plant and on *Salix fragilis* to produce adults that appeared to be normal; larvae confined on *A. crispa* var. *mollis* Fern. refused to feed.

Distribution.–Coasts of British Columbia and southernmost Alaska; probably southward on humid coasts. The specimens seen are from:–

ALASKA: Ketchikan (from pupae on *Alnus*).

BRITISH COLUMBIA: Cowichan Lake (*Alnus*), Glendale Cove (*Alnus*), Kennedy Lake (*Alnus*), King Island (*Alnus*), Klanawa River (*Alnus*), Nanaimo, Rivers Inlet (*Alnus*), Sarita River (*A. rubra*).

Holotype, ♂; *allotype*, ♀; 10 ♂ and 6 ♀ *paratypes.*–King Island, Fisher Channel, coast of British Columbia at latitude 52°; July 4, 1950; on *Alnus* sp.; No. 6159 in the Canadian National Collection, Ottawa.

Notes.–*C. a. littorea* is presumably a well-defined subspecies that becomes darker to the north. No other species of the group is known to occur within its range. Lightly maculate, southern specimens of *a. littorea* resemble the most heavily maculate, northern specimens of *a. interna* and some specimens of *falsa* and *knabi;* dark, northern specimens resemble *aeneicollis* and dark specimens of *falsa.* In *a. littorea* the average size is greater than in any of its western allies.

5. *Chrysomela walshi* n. sp.

Chrysomela interrupta, in the sense (in part) of: Rogers, 1856, p. 37; Suffrian, 1858, p. 388; Beller and Hatch, 1932, p. 97.
Plagiodera interrupta, in the sense (in part) of Stål, 1865, p. 293.
Lina interrupta, in the sense (in part) of Schaeffer, 1928, p. 42.
Plagiodera lapponica, in the sense (in part) of Crotch, 1873, p. 53.

Adult.–Length of males, 5.2 to 6.6 mm.; of females, 6.1 to 7.4 mm. Head and dark parts of pronotum and femora with greenish reflections. Head entirely dark; each antenna usually with the basal segment and from one to five apical segments dark or infuscate. Area between the pronotal sulci usually entirely dark, rarely with pale or rufescent areas; the pronotum externally pale, with a dark spot, rarely lacking, on each side; the spot usually attached, often very broadly so, to the dark discal area, rarely expanded to cloud part or most of the lateral region.

Elytra (Figs. 16-19) pale; each sometimes with seven discrete black spots, the suture then usually entirely pale; usually with the spots of one or more pairs joined and the suture largely or entirely pale; the darkest specimens with the spots of the basal pair joined basally as well as apically, the median spots joined, the postmedian spots joined together and to the subapical spot, and the sutural interval entirely dark; the elytra sometimes with all spots obscure, rarely quadrimaculate.

Body beneath very rarely entirely pale, rarely pale except for the sides of the metathorax, usually largely or almost entirely infuscate or dark. Legs entirely pale; pale except for the femora entirely or in part; or dark except for a part of each tibia.

Immature stages.–Eggs usually varying from white to very pale yellow, rarely deep yellow. Larvae of the third instar dichromatic.

Geographic variation.—This concerns the colour of adults, eggs, and possibly of larvae of the third instar. Fully maculate adults from Delhi, southernmost Ontario, show the same range of variability but average darker than those of the type series, which resemble those from other parts of the Ottawa district. Of 124 specimens from Delhi, the elytral spots are discrete in 16.9 per cent; the spots of one pair are joined in 29.8 per cent, and those of two or three pairs are joined in 53.2 per cent. In the type series of 102 specimens, the spots are discrete in 51.9 per cent; those of one pair are joined in 24.5 per cent, and those of two or three pairs are joined in 23.5 per cent. The legs are entirely pale in 13.1 per cent of the Delhi series and in 54.9 per cent of the type series. In a single specimen of each series, the body beneath is entirely pale; the dark or infuscate ventral areas are more extensive in most of the Delhi specimens than in most specimens of the other series. Five specimens of the Delhi series have the elytra quadrimaculate; this form is not known from other localities.

Of the egg masses observed, seven from Delhi and all of the large number from the type locality varied from white to very pale yellow; two masses from Delhi were deep yellow. Of larvae in the third instar, 54.0 per cent of 98 larvae from Delhi and 63.9 per cent of 236 from the type locality belong to the pale form. All egg masses from which mature larvae were reared produced larvae of both the pale and dark forms.

Food relationships.—The species feeds on *Populus balsamifera* L. (= *Tacamahacca* Mill.), and appears to be monophagous. At Delhi, Ont., the food-plant, supporting a populous colony of larvae and adults, was interspersed with *P. tremuloides* Michx. and *P. grandidentata* Michx. No chrysomelas were found on these aspens except five larvae, almost mature, feeding on small *P. tremuloides* growing beneath infested *P. balsamifera*. A populous colony of *Chrysomela knabi* occurred 100 feet distant on *Salix* sp.

Newly hatched larvae from Arnprior, Ont., were tested in the laboratory. Of 201 larvae from nine egg masses given *P. balsamifera*, 12.4 per cent died in the first instar and 75.1 per cent attained the adult state. Larvae accepted *Salix fragilis* readily and developed on it with similar mortality and as rapidly as on the natural food-plant. Of 1,155 larvae from 65 egg masses given *Alnus rugosa*, all from 13 masses refused to feed; these and all larvae from 11 other masses died without moulting Total mortality in the first instar was 84.8 per cent, and 9.8 per cent died in the second instar. Twenty-one pupae, which produced 15 adults, were obtained from five of the egg masses. These adults appeared to be normal; they required about 10 per cent longer to develop than adults reared on the natural food-plant.

Distribution.—Known only from easternmost and southernmost Ontario and from the Ottawa Valley in Quebec. All specimens seen were collected from *Populus balsamifera* and are from:—

QUEBEC: Norway Bay.

ONTARIO: Angus, Arnprior, Delhi, Dwyer Hill, Merivale, Roebuck, Spencerville.

Holotype, ♂; *allotype*, ♀; 41 ♂ and 59 ♀ *paratypes*.—Arnprior (near Ottawa), Ontario, May and June, 1942 to 1946 (W. J. Brown), on *Populus balsamifera* L.; No. 6160 in the Canadian National Collection, Ottawa. The types are from a single colony.

Notes.—*C. walshi* is intermediate in colour and average size between *a. alnicola* and *knabi;* the palest specimens resemble average specimens of the former, and the darkest are like average eastern specimens of the latter. Compared to extralimital allies, *walshi* cannot be distinguished from *a. interna*,

and the darkest specimens of *walshi* are similar to pale specimens of *falsa* and to the palest of *a. littorea.*

6. *Chrysomela knabi* n. sp.

Chrysomela interrupta, Rogers, 1856, p. 37 (in part); Suffrian, 1858, p. 388 (in part); Beller and Hatch, 1932, p. 97 (in part); Wilcox, 1954, p. 421.
Plagiodera interrupta, Stål, 1865, p. 293 (in part).
Lina interrupta, Blatchley, 1910, p. 1160, Fig. 504; Schaeffer, 1928, p. 42 (in part), 1934, p. 480.
?*Chrysomela interrupta* 4-*punctata* Suffrian (not *C. quadripunctata* Linnaeus, 1758), 1858, p. 389 [type: United States].
Plagiodera lapponica, Crotch, 1873, p. 53 (in part); Riley, 1880, p. 160, Fig. 63.
Lina lapponica, Lugger, 1889, p. 55, Fig. 6; Bruner, 1890, p. 91, Fig. 64.
Lina interrupta quadriguttata Schaeffer (not *Chrysomela quadriguttata* Fabricius, 1781), 1928, p. 43 (the paratypes from New Jersey).
Chrysomela interrupta quadriguttata, Beller and Hatch, 1932, p. 98 (in part).

Adult.—Length of males, 5.8 to 6.9 mm.; of females, 6.5 to 7.8 mm. The dark parts, at least on the head and pronotum, with feeble greenish or bluish reflections in certain lights. Head entirely dark; each antenna with the basal segment and five apical segments dark. Pronotum with the area between the sulci entirely dark, pale externally except for a median spot on each side; the spot infrequently obsolete, always small, usually attached to the dark discal area.

Elytra (Figs. 20-23) of fully maculate individuals extremely variable. Each elytron commonly with the basal spots joined apically to partially enclose an elongate, pale intrusion; the median spots joined or free; the postmedian spots very broadly joined together and narrowly joined externally to the subapical spot; the median and postmedian markings extending along the suture, which is entirely dark except immediately behind the scutellum. Each elytron of the darkest specimens with the basal spots fused into a round blotch, which encloses a small, pale spot and is narrowly separated from the broadly joined median spots; the latter narrowly separated from a posterior blotch, which encloses a small, pale spot and is formed by the postmedian pair and the subapical spot; the median and posterior markings attaining the suture, which is entirely dark. Each elytron of the palest fully maculate specimens with seven small, discrete spots or with only the spots of the postmedian pair joined; the suture entirely pale. The elytra sometimes quadrimaculate (Fig. 21).

Body beneath blackish; the prothoracic sides broadly pale; the intercoxal parts of the metasternum and first abdominal segment often rufescent; the abdominal sides nearly always very narrowly pale, at least apically; the apical margins of the abdominal segments, except basally, often very narrowly pale or rufescent. Femora dark; tibiae usually largely pale, their extreme bases then dark and their inner sides and apical portions dark or infuscate; the tibiae rarely entirely dark except for obscurely pale median areas; tarsi brown or blackish.

Immature stages (observed only in southern Ontario).—Eggs virtually always deep yellow. Larvae virtually always dark.

Whitish eggs and larvae of the pale form were observed once. At Port Rowan, Ont., six pale and six dark larvae, apparently from a single egg mass, were found on a small willow; all matured into average adults. One female taken from a colony at Port Rowan produced two egg masses both of which were whitish.

Geographic variation.—This concerns the size of the elytral spots and the frequency of quadrimaculate elytra. Of the fully marked specimens from eastern localities, nearly all agree well enough with the common form described above, and others are of the darkest form described. In western specimens

the spots are smaller and are less frequently joined or entirely free. Of the 149 fully maculate specimens from the type locality, Point Pelee, Ont., the spots of each basal pair are joined in 89.9 per cent, and the subapical spot is joined externally to the fused postmedian pair in 83.2 per cent. In 97 specimens from Lawrence, eastern Kansas, the basal spots are joined apically in 45.8 per cent, and the subapical spot is joined to the fused postmedian pair in 44.3 per cent; in 43 specimens from Chandlerville, west-central Illinois, the percentages are 69.8 and 55.8 respectively. In none of the specimens from Lawrence and Chandlerville are the basal spots joined basally. The darkest specimens of the Lawrence series resemble average specimens from Ontario and the eastern states, and the palest are like those from more western localities. Of 35 fully maculate specimens from the Canadian prairies, all spots are free in 19, only the postmedian are joined in 15, and the basal spots are joined in one. The small series from Colorado, Montana, and adjacent regions resemble those from western Canada.

The form with quadrimaculate elytra is rare or lacking east of the ninety-seventh meridian but is abundant westward. Only ten specimens of 313 from Ontario, including one in the type series, and none of 312 from eastern Kansas are quadrimaculate; the quadrimaculate form is known from West Virginia and New Jersey. Of 164 specimens from 25 localities west of the meridian, 41 specimens from 18 localities are quadrimaculate.

Food relationships.—The primary food-plants are certain species of *Salix*, including *S. fragilis* L. and *S. amygdaloides* Anderss. The beetle seems to avoid some species of willow, but the matter has not been investigated. Adult beetles were observed in significant numbers on *Populus deltoides* Marsh., as well as on *Salix* sp., in April at Lawrence, Kans., and on *P. nigra* L. '*italica*', *P. grandidentata* Michx., and *P. tremuloides* Michx. in Ontario in May. As no breeding colonies have been found on *Populus*, it is probable that *Populus* normally serves as a host only to adults, which accept the immature leaves in early spring.

Newly hatched larvae from Ontario were tested in the laboratory. Larvae given *S. fragilis*, *P. deltoides*, and *P. balsamifera* matured with little or no mortality. All larvae, about 200, given *Alnus rugosa* fed sparingly the first day and died without moulting within four days.

Distribution.—Southernmost Ontario, southernmost New Hampshire, and western North Carolina to southern Alberta and New Mexico. The specimens seen are from:—

ONTARIO: Chatham (*Salix*), Elginfield (*Salix*), Fonthill (*Salix*), Forestville (*P. grandidentata*), Hagersville (*P. tremuloides*), Jordan (*Salix*), Leamington (*Salix*), Newbury (*Salix*), Normandale (Lombardy poplar), Pelee Island (*Salix*), Point Pelee (*Salix*), Simcoe (*Salix*), Walsingham (*Salix*).

MANITOBA: Hargrave, Treesbank.

SASKATCHEWAN: East End, Estevan, Indian Head (*Salix*), Oxbow (willow).

ALBERTA: Irvine (*S. amygdaloides*), Lethbridge (willow), Medicine Hat (willow).

NEW HAMPSHIRE: Hampton.

MASSACHUSETTS: Framingham, Humarock, Revere, Tyngsboro.

NEW YORK: Little Valley, Pelham, Rosedale, West Point.

NEW JERSEY: Alpine, Berkley Heights, Green Village, Hewitt, Morristown.

PENNSYLVANIA: Allegheny Co. (willow), Broomall, Clarks Valley, Clearfield (willow), Dauphin, Easton, Effort, Kane (aspen), Lenhartsville, Mount Alto, Mount Holly Springs, Phillipsburg, Pocono Mountains, Sumneytown, Windgap.

VIRGINIA: Clifton Forge.

NORTH CAROLINA: Boone (willow), 8 miles north of Deep Gap, Pine Ridge, Sunburst, Swannanoa Valley.

WEST VIRGINIA: Fairmont (*Salix*), Kanawha Station (*Salix*), White Sulphur Springs.

OHIO: Cleveland, Clinton Co., Gambier, Hamilton, Hocking Co., Marietta.

MICHIGAN: Bloomfield, Ecorse (willow), Greenville (willow), Mason, Romeo (willow).
INDIANA: Brown Co. (aspen), Knox, Marion Co., Lake Maxncuche (willow).
ILLINOIS: Centralia, Chandlerville (*Salix*), Chicago, Glendon Park, Greenville, Pekin, Peoria, St. Joseph, Union Co., Urbana.
WISCONSIN: Dacne Co., Madison (*Salix*).
IOWA: Ames, Boone, Burlington, Council Bluffs, Fort Madison, Iowa City, Muscatine, Riverton, Solon.
MISSOURI: Bethany, Overland, St. Charles, St. Louis, St. Joseph (willow), Scott Co.
ARKANSAS: Bentonville.
SOUTH DAKOTA: Volga.
NEBRASKA: Blake, Imperial, McCook, Malcolm, West Point.
KANSAS: Cheyenne Co., Gove Co., Johnson Co., Kansas City, Lawrence (*Salix*, *P. deltoides*), Leavenworth Co., Linn Co., Logan Co., Onaga, Riley Co., Topeka.
OKLAHOMA: Ardmore (*Salix*), Grady Co., Greer Co., Kiowa Co., Norman, Woodward, Shattuck.
TEXAS: Davis Mountains (willow).
COLORADO: Berkeley, Boulder (*Salix*), Colorado Springs, Denver, Evergreen, Fort Collins, Fort Lupton, Littleton, Pueblo.
NEW MEXICO: Magdalena Mountains.
MONTANA: Forsyth, Havre, Ulm.

Holotype, ♂; *allotype*, ♀; 69 ♂ and 79 ♀ *paratypes*.—Point Pelee, Ontario, June and July, 1940 (W. J. Brown), on *Salix fragilis* L. and *Salix* sp.; No. 6162 in the Canadian National Collection, Ottawa. The types are from a single colony.

Notes.—As noted above, *knabi* shows east-west clines in colour. The elytral spots become progressively smaller to the west, and individuals with quadrimaculate elytra are abundant only on the Great Plains. The species can usually be distinguished from *interrupta* by the form of the elytral spots, as explained in the notes on the latter. *C. knabi* will not be confused with average specimens of *a. alnicola*, but eastern specimens of *knabi* do not differ from the darkest specimens of *walshi*. Some specimens of all species and subspecies of the group, except *aeneicollis*, resemble some specimens of *knabi*.

7. *Chrysomela falsa* n. sp.

Lina lapponica, Mannerheim, 1853, p. 255.
Plagiodera lapponica, Crotch, 1873, p. 53.
Lina interrupta, in the sense (in part) of Schaeffer, 1928, p. 42.
Chrysomela interrupta, in the sense (in part) of Beller and Hatch, 1932, p. 97.
?*Lina interrupta quadriguttata* Schaeffer (not *Chrysomela quadriguttata* Fabricius, 1781), 1928, p. 43 (type and the paratypes from Alberta only) [type: Edmonton, Alberta; U.S. National Museum].
Chrysomela interrupta quadriguttata, Beller and Hatch, 1932, p. 98 (in part).

Adult.—Length of males, 5.2 to 6.6 mm.; of females, 6.3 to 7.3 mm. The dark parts feebly metallic in certain lights. Head entirely dark; each antenna with the basal segment and five or six apical segments dark. Pronotum with the area between the sulci entirely dark; usually pale externally except for a median spot on each side; the spot rarely free, usually very broadly attached to the dark discal area, sometimes expanded to render the lateral area largely dark or infuscate.

Elytra (Figs. 24-26) extremely variable; very rarely entirely pale; commonly quadrimaculate; each elytron very rarely with seven discrete spots or with only the postmedian spots joined. The elytra most commonly with the dark spots covering half or more of the surface; each then with the basal spots joined apically, basally, or at both ends; the median spots joined or free; the postmedian spots fused and joined externally, internally, or on both sides to the subapical spot; the suture largely or entirely dark. Each elytron of the darkest specimens entirely dark except for the external margins, at least at the apex, and four or five small discal spots which are sometimes obscure.

Body beneath largely blackish except rarely; the prothoracic sides broadly pale; the intercoxal parts of the metasternum and abdomen sometimes feebly rufescent; the abdominal sides very narrowly pale, at least apically; the apical margins of the abdominal segments sometimes very narrowly rufescent. Femora usually entirely dark, infrequently pale basally or entirely pale; tibiae usually largely pale, their extreme bases then dark and their apical portions dark or infuscate; the tibiae sometimes entirely pale or entirely dark except for obscurely pale median areas; tarsi pale to blackish.

Immature stages (observed at Gander, Nfld., Gillam, Man., and throughout the Kenai Peninsula, Alaska).—Eggs whitish, very pale yellow, or very pale green. Larvae of the third instar dichromatic; the colour sometimes dilute in the dark form; the pale form extremely rare.

Geographic variation.—This concerns the colour of adults and possibly of larvae in the third instar. The description of elytral colouration is based on the type series. Considering only fully maculate specimens, the description suits well enough series from other localities except that lightly maculate specimens, always scarce, are lacking in some series, notably in those from British Columbia and Newfoundland. The colony that supplied the type series was very populous and occupied several square miles. As in other large colonies of the Kenai Peninsula, the elytra were extremely variable. Small, isolated colonies frequently showed restricted variability. Such colonies were probably established by one or two females, which did not carry the total variability of the species.

The frequency of quadrimaculate elytra varies exceedingly; the quadrimaculate form is abundant in Alberta and northwestward but is usually scarce or lacking westward and in the East. The frequencies of the quadrimaculate form are: in Alaska, 35.0 per cent of 234 specimens from Moose Pass, 0.0 per cent of 27 from Haines; in all of British Columbia, 0.0 per cent of 68; in Yukon Territory, 65.3 per cent of 101 from Burwash Landing; in Northwest Territories, 29.2 per cent of 41 from Norman Wells, 39.1 per cent of 69 from Ft. Smith; in Alberta, 86.8 per cent of 53 from Olds, 78.2 per cent of 23 from Wimborne, 69.0 per cent of 71 from Blackfoot, and 57.7 per cent of 26 from Elkwater; in Manitoba, 5.5 per cent of 18 from Norway House; in Labrador, 17.1 per cent of 35 from Goose Bay; in Newfoundland, 3.8 per cent of 158 from Gander and 0.0 per cent of 51 from St. John's.

The spot on each side of the pronotum is expanded to cloud a large part of the lateral area in some specimens of all series except those from Alberta in which, too, the elytra are usually quadrimaculate. The lateral areas are clouded in about one-fifth of the specimens from Moose Pass and in two-thirds of those from Haines. In the series noted above from Yukon Territory, Northwest Territories, British Columbia, and Labrador, from two-fifths to three-fourths of the specimens show clouded pronotal sides. Such clouding occurs in two of the specimens from Norway House and in only four of those from Newfoundland. The frequency of the clouding and of quadrimaculate elytra, like the size of the elytral spots, may vary with population size.

The body beneath or legs are unusually pale in many specimens from Gander, Nfld., Norway House, Man., and Elkwater, Alta. Of 158 specimens from Gander, the body beneath is half pale to largely pale in 6.3 per cent, and the legs are entirely pale in 32.2 per cent; in 51 specimens from St. John's, Nfld., 130 miles distant, the underside is largely dark in all, and the legs are entirely pale in one. In the other series, 18 from Norway House and 26 from Elkwater, the underside is largely dark in all, and the legs are entirely pale in 27.7 and 23.1 per cent respectively.

Larvae of the pale form were observed only in the Kenai Peninsula. Of 326 larvae collected from all food-plants at Moose Pass, one was pale. In the laboratory, one pale larva was reared in one culture and four in another from eggs taken on *Salix;* four pale larvae appeared in one culture from eggs taken on *Populus trichocarpa.*

Food relationships.—The food-plants are certain species of *Salix*, including *S. discolor* Muhl., *Populus balsamifera* L., *P. trichocarpa* Torr. and Gray, and rarely *P. tremuloides* Michx. The beetle avoids entirely some species of *Salix* that have pubescent leaves. It shows no preference between certain species of *Salix* and *P. trichocarpa* or *P. balsamifera* but usually avoids entirely *P. tremuloides.* The author has observed it on the last only at Moose Pass, Alaska, where it was abundant on aspens growing among heavily infested willows and poplars. Perhaps the beetle, when very abundant, expands its food tolerances, as do some other chrysomelids.

Newly hatched larvae were tested in the laboratory. At Gander, Nfld., all larvae were obtained from adults collected from *S. discolor;* following are the results obtained there. Of 46 larvae reared on *S. discolor*, all attained the adult state. Of 36 larvae reared on *P. tremuloides*, 86.1 per cent reached the adult state. Of 141 larvae given *Alnus rugosa*, 133 died in the first, the remainder in the second, instar.

The following results were obtained with larvae from Moose Pass. With larvae from adults collected on *Salix* sp., all of 47 given *Salix* and all of 84 given *P. trichocarpa* attained the adult state; of 182 given *Alnus tenuifolia*, 77 died in the first instar, 41 in the second, and 11 attained the adult state. With larvae obtained from adults collected on *P. trichocarpa*, all of 99 given *P. trichocarpa* and all of 38 given *Salix* sp. reached the adult state; of 260 given *A. tenuifolia*, 160 died in the first instar, 38 died in the second, and 16 attained the adult state. Of the adults reared on *A. tenuifolia*, nearly all were stunted; although they were fed *P. trichocarpa*, most of them died within five days.

Distribution.—Newfoundland to northern Labrador, central Ontario, west-central British Columbia, and Alaska. Specimens have been seen from the following localities:—

NEWFOUNDLAND: Gander (*Salix*), St. John's (*Salix*, poplar).

LABRADOR: Hebron (*Salix*, reared from larvae), Goose Bay (*Salix*), Nutak (*Salix*, reared from larvae).

QUEBEC: Great Whale River (*Salix*).

ONTARIO: Chapleau (balsam poplar), Cochrane (balsam poplar), Eva Lake (willow), Foleyet (willow, balsam poplar). Franz (willow), Gogama (*P. tremuloides*), Graham (willow), Hurkett (willow), Oba (balsam poplar), Red Lake (willow), Timmins (willow), Tionaga (balsam poplar).

MANITOBA: Fort Churchill, Gillam (*Salix*), Norway House (*Salix*).

SASKATCHEWAN: Rutland (*Salix*), Waskesiu Lake (*Populus, Salix*).

ALBERTA: Alhambra (*P. balsamifera*), Blackfalds (*Salix*), Blackfoot (*P. tremuloides, Salix*), Blairmore (*Salix*), Chipman, Cold Lake, Crowsnest Pass (*P. balsamifera*), Edmonton, Elkwater (*P. balsamifera*), Endiang (*Salix*), Gull Lake, Jasper Park, Leslieville (*P. tremuloides*), Longview (poplar), Lynx Creek near Beaver Mines (*P. balsamifera*), Morin, Mundare, Nordegg, Olds (*Salix*), Ranger Station 35 miles southwest of Sundre (*P. balsamifera*), Tofield, Waghorn, Waterton, Wimborne (*Salix*).

BRITISH COLUMBIA: Chilkat Pass (*P. trichocarpa, Salix*), Duke Creek (*P. trichocarpa*), Enterprise Creek (*P. trichocarpa*), Hastings Arm (*P. trichocarpa*), Skutz Falls, Stanley, Terrace, Work Channel (*Salix*).

NORTHWEST TERRITORIES: Fort Reliance, Fort Resolution (*P. balsamifera*), Fort Smith (*P. balsamifera, P. tremuloides, Salix*), Fort Wrigley, Norman Wells (*P. balsamifera, Salix*), Saw Mill Bay (*Salix*), 40 miles south of Hay River.

YUKON TERRITORY: Big Salmon, Burwash Landing (balsam poplar), Hootalinqua, Kirkman Creek, Lower Laberge, Selkirk, Yukon Crossing, Watson Lake (*P. tremuloides*).

ALASKA: Cooper Landing (*Salix*), Fort Yukon, Haines (*P. trichocarpa*), Homer (willow), Hope (*P. trichocarpa, Salix*), Lawing (*P. trichocarpa*), Moose Pass (*P. trichocarpa, P. tremuloides, Salix*), Skilak Lake (*P. trichocarpa*), Sunrise (*Salix*).

Holotype, ♂; *allotype*, ♀; 53 ♂ and 49 ♀ *paratypes*.—Moose Pass (mile 37.5 on the road north from Seward), Kenai Peninsula, Alaska; June 7 and 9, 1951; 1000 ft. (W. J. Brown); on *Salix* sp.; No. 6161 in the Canadian National Collection, Ottawa. The types are from a single colony.

Notes.—*C. falsa* will not be confused with the much paler *a. alnicola*, but pale specimens of *falsa* cannot be distinguished from *a. interna*, which occurs in the range of *falsa*. *C. falsa* averages darker than any of the allied forms except *aeneicollis* and *a. littorea*, and some specimens of *falsa* cannot be distinguished from specimens of these or from some of *knabi* and *walshi*.

The type of the preoccupied name *quadriguttata* Schaeff. is a quadrimaculate specimen from Edmonton, Alta. Because of the locality and its dark underside and femora, the type is referred provisionally to *falsa*.

8. *Chrysomela aeneicollis* (Schaeffer)

Lina interrupta aeneicollis Schaeffer, 1928, p. 43 [type: Lake Louise, Alberta; U.S. National Museum].

Chrysomela interrupta aen[e]icollis, Beller and Hatch, 1932, p. 97.

Chrysomela interrupta quadriguttoides Beller and Hatch, 1932, p. 98 [type: Stillaguamish Creek, Washington; Hatch Collection, Seattle, Wash.]. *New synonymy*.

Adult.—Length of males, 5.0 to 6.0 mm.; of females, 6.1 to 6.9 mm. Head and pronotum usually with feeble metallic reflections. Head entirely dark; antennae entirely dark, with the subbasal segments rufescent, or with segments two to five or six pale and more or less infuscate. Pronotum usually entirely dark, frequently with the anterior angles rufescent, rarely with the lateral margins narrowly rufescent.

Elytra (Figs. 27-29) rarely pale and immaculate or quadrimaculate; when fully maculate, the dark areas expanded to cover half or more of the disk. Each elytron then, except in the darkest specimens, with the basal spots joined both basally and apically except rarely; the median spots joined or free; the postmedian spots fused and joined externally, except rarely, and internally to the subapical spot; the suture entirely dark. The darkest specimens with each elytron entirely dark except for eight small spots; such specimens scarce.

Body beneath entirely blackish except for the sides of one or two apical abdominal segments, which are very narrowly pale or rufescent. Legs, except for the tibiae, entirely dark; the tibiae bicoloured or, rarely, dark except for rufescent areas.

Immature stages (from Lavington, B.C.).—Eggs creamy-white. Larvae constantly blackish; both larvae and pupae darker than in the other species of the *interrupta* group.

Geographic variation.—None observed.

Food-plant.—*Salix*.

Distribution.—Mountains of southern British Columbia and southern Alberta to southwestern Colorado and Tulare Co., California. The specimens studied are from:—

ALBERTA: Banff; Bison Creek, Banff National Park; Cadomin; Jasper Park; Laggan; Lake Louise (*Salix*); Leyland (willow); Sterco (willow); Waterton.

BRITISH COLUMBIA: Agassiz; Copper Mountain (*Salix*); Emerald Lake; Endako; Field; Glacier; Indian River; Lavington, 2,300 ft. (*Salix*); Lillooet, 6,500 ft. (willow); Mara Mountain; Mountain Creek (*Salix*); Mount Apex, 5,000 ft.; Mount Garibaldi; Mount McLean; Mount Revelstoke Park, 6,200 ft.; Penask Lake (*Salix*); Nation River (*Salix*), Salmon Arm; Sicamous.

B & Z LIBRARY

WASHINGTON: Mount Rainier (willow).
MONTANA: Eldridge; Glacier National Park.
IDAHO: Ucon.
OREGON: Astoria; Chandler State Park; Corvallis; Crater Lake; Drews Gap, Klamath Falls; Fort Klamath; Mount Adams, 5,000 ft.; Tanby Creek.
WYOMING: Medicine Bow Range; Stinking Water Creek, 7,000 ft.
COLORADO: Gothic, 9,600 ft.; Gunnison (willow); Leadville, 10,300 ft.; Malta, 9,400 ft.; Monument Gulch to Montrose, 7-9,000 ft.; Pike National Forest (willow); Placerville, 8-10,000 ft.
UTAH: Granite; Logan; Provo Canyon; Silver Lake.
CALIFORNIA: Alturas; Benton Station, Mono Co.; Blue Lake, Lassen Co.; Cedar Pass, Modoc Co.; Davis Creek, Modoc Co.; Gaylor Lakes, Yosemite National Park; Goose Lake, Modoc Co.; Lake City; Leevining; Little River, Alpine Co.; South base of Mount Dana, Tuolumne Co.; Sardine Creek, Mono Co.; Sonora Pass, 9,624 ft. (*Salix*); Tioga Pass; Tulare Co. (*Salix*); Warner Mountains.

Notes.—The series comprise about 470 specimens, including 43 from the type locality, Lake Louise, Alta. Only 15 of the specimens belong to the quadrimaculate form (*quadriguttoides* Beller and Hatch), which, however, seems to occur throughout the range of the species (British Columbia to California; Colorado). The species is characterized by its small size and dark colour and is readily separable except from the darker forms of *falsa* and *a. littorea*. It averages smaller than these and appears to breed only on *Salix*. In *aeneicollis* the margins of the elytral spots (Fig. 27), especially the posterior of the median spots and the anterior of the postmedian spots, are usually more jagged than in the allied species.

9. *Chrysomela scripta* Fabricius

Chrysomela scripta Fabricius, 1801, p. 438 [type: Carolina, presumably in the Bosc Collection, Muséum National d'Histoire Naturelle, Paris (Blake, 1952, p. 66)]; Olivier, 1807, p. 559, Pl. 8, Fig. 120; Rogers 1856, p. 37; Suffrian, 1858, p. 389; Wilcox, 1954, p. 422.
Melasoma scripta, Melsheimer, 1853, p. 124.
Plagiodera scripta, Stål, 1865, p. 294; Crotch, 1873, p. 53 (in part); Riley, 1880, p. 159, Figs. 61, 62 (in part).
Lina scripta, Henshaw, 1885, p. 110; Lugger, 1889, p. 53, Fig. 3 (in part); Packard, 1890, p. 428, Figs. 157, 158 (in part); Bruner, 1890, p. 83, Figs. 48, 50 (in part); Jacoby, 1882, p. 194, 1891, p. 244, Pl. 10, Fig. 2; Blatchley, 1910, p. 1160, Fig. 505 (in part); Blatchley, 1924, p. 4; Schaeffer, 1928, p. 43 (in part).
Melasoma 14-notata (F. V. Melsheimer MS.) F. E. Melsheimer, 1853, p. 124 (*nomen nudum* cited in synonymy).
Melasoma variegata (Forster MS.) Melsheimer, 1853, p. 124 (*nomen nudum* cited in synonymy).
Melasoma lineatopunctata, Weise, 1916, p. 142 (in part).
Chrysomela lineatopunctata, in the sense (in part) of Beller and Hatch, 1932, p. 99.

Adult.—Length of males, 5.4 to 7.8 mm.; of females, 6.3 to 9.0 mm. Elongate-oval, the width from 50 to 55 per cent as great as the length; only moderately convex.

Dark parts blackish; except for those of the elytra, with a greenish cast. Head dark; antennae sometimes entirely dark, each usually with the basal and the five distal segments blackish, the intermediate segments then pale or more or less infuscate. Pronotum with the area between the sulci usually entirely dark or pale in part anteriorly, sometimes entirely rufescent or with a dark spot on each side and another before the scutellum; the lateral areas of the pronotum and the lateral ridge of each elytron pale red in breeding specimens, dull yellow like the elytral disk or reddish-yellow in pinned specimens; a small dark spot on each side of the pronotum, this rarely lacking, occasionally attached to the dark discal area. Each elytron (Figs. 30-31) with a narrow sutural stripe and seven elongate spots dark; the markings never with bluish reflections; the sutural stripe frequently abbreviated basally, present only on the apical declivity in the

palest specimens; the spots placed two (humeral and subscutellar), three (median), and two (subapical), virtually always discrete except for the outer subapical which is frequently attached to the sutural stripe; the three sublateral spots forming an interrupted band; the intermediate of the median spots very elongate, nearly always between six and eight times as long as wide; some of the median and posterior spots rarely dilute, reduced, or entirely lacking; a very small additional spot frequently present at the middle of the extreme base. Colour of the underside and legs varying geographically.

Head moderately finely and closely punctate. Pronotum with the sulci strongly impressed and coarsely and densely punctate; the lateral areas with close coarse and fine punctures; the discal area variable, with few or numerous moderately fine punctures at middle and with or without very fine and sparse punctures throughout. Elytra moderately coarsely punctate, most of the punctures separated by distances equal to or greater than their diameters; each elytron with the lateral ridge strongly delimited internally and, in the female, with the apex distinctly produced.

Eggs (from Leamington, Ont., and Coutts, Alta.).—Always deep yellow.

Geographic variation.—In all specimens from peninsular Florida, the antennae, legs, and the underside, except for the margins of two or three apical segments and the prothoracic sides, are entirely dark. In all other series the intermediate antennal segments are more or less pale, and the legs are pale in part. Specimens from Gadsden Co., northwestern Florida, and from South Carolina have the trochanters, the tibiae at middle, and often the femoral bases rufescent or pale. Other eastern series average paler; usually the basal fourth to half of each femur is pale, and the tibiae are pale except basally and apically. Series from central United States, the Prairie Provinces, and British Columbia average paler still; the legs are frequently largely or entirely pale, and the underside is more frequently pale in part or, very rarely, entirely pale. In all specimens of the palest series, six from Parma, Idaho, the pronotum is largely pale, the elytral spots are reduced in size, the legs are entirely pale, and the thorax beneath, except for most of the metasternum, is largely or entirely pale. The other series show no geographic variation in the colour of the dorsal parts.

Food-plants.—These are certain species of *Salix* and *Populus*. The beetle is not known to feed on *P. tremuloides* Michx. and *P. grandidentata* Michx. or on species of *Salix* that have the mature leaves pubescent.

Distribution.—Southwestern Massachusetts; shores of Lake Erie in Ontario; southern Saskatchewan; southernmost Manitoba, Alberta, and British Columbia to southernmost Florida and Louisiana; southern Texas; southeastern New Mexico; eastern Utah; southwestern Idaho and Washington; Mexico. The specimens seen are from:—

ONTARIO: Leamington (*Salix, P. deltoides*), Normandale (Carolina poplar), Pelee Island (*Salix*), Point Pelee (*Salix*).
MANITOBA: Treesbank.
SASKATCHEWAN: Estevan (*Populus*), Indian Head (*Populus*), Kindersley (*Salix*), Limerick (*Populus*), Regina, Saskatoon (cottonwood).
ALBERTA: Coutts (northwest poplar), Elkwater Park, Irvine (*Salix amygdaloides*), Lethbridge (cottonwood), Manyberries (Russian poplar), Medicine Hat, Redcliff (Carolina poplar).
BRITISH COLUMBIA: Agassiz, Cawston, Creston, Hedley (*P. trichocarpa*), Kamloops, Kaslo, Kelowna (poplar), Keremeos, Oliver, Peachland, Salmon Arm (*P. trichocarpa*), Tranquille, Vernon (*Salix*).
MASSACHUSETTS: Agawam (willow), Chicopee (*P. balsamifera, Salix*), Springfield.
CONNECTICUT: Hartford, Windsor.
NEW YORK: Lynbrook (poplar).

PENNSYLVANIA: Overbrook, Philadelphia.
NEW JERSEY: Clementon, Clifton, Phillipsburg, Westville.
MARYLAND: Beltsville (poplar), Cabin John, Glen Echo, Plummers Island.
DISTRICT OF COLUMBIA.
VIRGINIA: Clover, Dismal Swamp, Falls Church, Glencarlyn, Hampton (willow), Holland (willow), Vienna.
NORTH CAROLINA: Greensboro, Raleigh (*Salix*), Southern Pines, Wilmington (willow).
SOUTH CAROLINA: Adams Run, Calhoun, Camden, Charleston (*Salix*), Florence, Ridgeway.
OHIO: Bedford, Chillicothe, Gambier, Hamilton Co.
GEORGIA: Clarke Co., Griffin (poplar), Savannah, Stone Mountain.
FLORIDA: Chattahoochee (*Salix*), Crescent City, Enterprise, Fort Myers, Gainesville, Gulf Hammock, Hendry Co., Homestead, Jacksonville, Lake Placid, Miami, Monroe Co. Moore Haven, Oldtown, Orlando, Paradise Key, Pasco Co., Quincy, Saint Augustine, Saint Petersburg, Sanford, Tampa, Tarpon Springs, Winter Park.
MICHIGAN: Douglas Lake (near Pellston), Marquette.
INDIANA: Evansville, Lafayette, Orleans.
KENTUCKY: Maysville.
TENNESSEE: Hurricane Mills, Nashville.
ALABAMA: Blount Springs, Dothan, Eutaw, Mobile, Montgomery, Thomasville.
ILLINOIS: Champaign, Chandlerville (*Salix*), Chicago, Florence, Pittsfield, Urbana.
MISSISSIPPI: Hattiesburg.
IOWA: Boone, Iowa City, Keokuk, Solon.
MISSOURI: Atchison Co.
ARKANSAS: Fort Smith, Hope, Little Rock, Texarkana.
LOUISIANA: Baton Rouge, Leesville, New Orleans, Ruston, Shreveport, Tallulah, Winnfield.
NORTH DAKOTA: Dickinson (cottonwood), Graybeard, Williston.
SOUTH DAKOTA: Brookings, Volga.
NEBRASKA: Blake.
KANSAS: Gove Co., Kansas City, Lawrence (*Salix, P. deltoides*), Logan Co., Lone Star (*Salix*), Onaga, Peabody, Riley Co.
OKLAHOMA: McAlester.
TEXAS: College Station, Columbus, Dallas, Denton Co., Greenville, Houston (willow), Lolita, New Braunfels, Tyler, Victoria.
COLORADO: Boulder, Colorado Springs, Crook, Denver, Fort Collins, Glenwood Springs, Grand Junction, Greeley, La Junta, Rocky Ford, Sterling.
NEW MEXICO: Albuquerque, Las Vegas, Roswell, San Ysidro, Tajique, Taos Co., Watrous.
MONTANA: Glendive, Kalispell, Park Co.
UTAH: Moab, Vernal.
IDAHO: Coeur d'Alene, Parma.
WASHINGTON: Centralia, Douglas Co., Pullman, Yakima.
MEXICO: Est. de Vera Cruz; Guadalupe, D. F.; Tlalenpautla, Mex.; Tlalpam, D. F.

Notes.—*C. scripta* is characterized by the elongate body and the elongate median spots of the elytra. However, small specimens cannot be separated from the larger, paler specimens of *laurentia*, which occours north of the range of *scripta*.

10. *Chrysomela laurentia* n. sp.

Lina scripta, Chagnon, 1938a, p. 17 (in part), 1938b, p. 305 (in part); in the sense (in part) of Schaeffer, 1928, p. 43.
Chrysomela lineatopunctata, in the sense (in part) of Beller and Hatch, 1932, p. 99.

Adult.—On the average smaller and with the dark areas relatively more extensive; otherwise as in *scripta*.

Length of males, 5.8 to 7.2 mm.; of females, 6.3 to 8.0 mm. Antennae with the intermediate segments always pale or rufescent. Pronotum with the area between the sulci always entirely dark; the dark spot of each side nearly always attached, usually broadly so, to the dark discal area. Sutural stripe of the elytra always attaining the base. Elytral spots (Figs. 32-34) frequently as in average specimens of *scripta*, the median spots then separated by distances subequal to their own widths; frequently larger and closer; frequently more

or less confluent; the elytral disk in the darkest specimens entirely black (one paratype only) or with several small streaks and spots pale; the lateral ridges always pale. Body beneath always entirely dark except for the prothoracic sides and the lateral margins of the two apical segments. Trochanters, tibiae except basally and apically, and usually the femoral bases pale or rufescent.

Eggs (from the type locality).—Dichromatic; all eggs of each mass either pink or deep yellow; pink masses about six times as numerous as yellow masses.

Geographic variation.—None observed.

Food-plants.—The primary food-plants are certain species of *Salix*, including *S. fragilis* L., *S. cordata* Michx., and *S. lucida* Muhl. In the spring the beetles feed freely on *Populus balsamifera* L. and *P. alba* L. As the leaves of these mature, the beetles abandon them except on the suckers, on which they persist and lay, and which are suitable food for the larvae. Larvae confined on mature leaves of these poplars fed persistently but found the leaves too hard; they suffered very heavy mortality and produced stunted adults. Very rarely adults and larvae occur in very small numbers on *P. tremuloides* Michx. and *P. grandidentata* Michx.

Distribution.—Lake St. John and James Bay, Quebec, to central Maine and New Hampshire, easternmost Ontario, Lake Superior, and Great Slave Lake. The specimens seen are from:—

QUEBEC: Abitibi region, Chelsea (*Salix*), eastern coast of James Bay, Hull (*Salix*), Norway Bay (*P. balsamifera*), Roberval, St. Hilaire.
ONTARIO: Arnprior (*Salix, P. balsamifera, P. grandidentata, P. alba*), Constance Bay (*Salix*), Gogama (*Salix*), Marmora (*Salix, P. balsamifera*), Merivale (*Salix, P. tremuloides*), Osgoode (in crow's nest, March 15; under bark of dead maple, August 20), Ottawa (*Salix*), Roebuck (*Salix*), Snow Road Station (*P. tremuloides*), Tweed (under bark of dead maple, July 6).
NORTHWEST TERRITORIES: Fort Resolution (*Salix*), Fort Smith (*Salix*).
MAINE: Penobscot Co.
NEW HAMPSHIRE: Franconia.
MICHIGAN: Isle Royale.

Holotype, ♂; *allotype*, ♀; 39 ♂ and 71 ♀ *paratypes*.—Arnprior (near Ottawa), Ontario, May 11, 1941 (W. J. Brown), on *Salix;* No. 6163 in the Canadian National Collection, Ottawa. The types are from a single colony.

Notes.—In series *laurentia* is readily separable from *scripta*, but large, pale specimens of the former resemble the smaller, darker specimens of the latter. The ranges of the two species do not come together, although at least one preferred food-plant of both, *Salix fragilis*, is abundant in the eastern parts of the intervening area. Unlike those of *laurentia*, the larvae of *scripta* are known to thrive on the mature leaves of several species of *Populus*.

11. *Chrysomela confluens* Rogers

Chrysomela confluens Rogers, 1856, p. 37 [type: "Oregon"; LeConte Collection, Museum of Comparative Zoology, Cambridge, Mass.]; Suffrian, 1858, p. 391.
Chrysomela lineatopunctata confluens, Beller and Hatch, 1932, p. 100.
Plagiodera confluens, Stål, 1865, p. 331.
Plagiodera scripta confluens, Crotch, 1873, p. 53.
Melasoma confluens, Gemminger and Harold, 1874, p. 3411.
Melasoma lineatopunctata confluens, Weise, 1916, p. 142.
Lina confluens, Henshaw, 1885, p. 110.
Lina scripta confluens, Leng, 1920, p. 295; Schaeffer, 1928, p. 43.
Plagiodera scripta, Crotch, 1873, p. 53 (in part); Riley, 1880, p. 161, Fig. 62 (in part).
Melasoma scripta, McCracken, 1907, p. 221, Pl. 1, Figs. 1-4.
Lina scripta, Packard, 1890, p. 432, Fig. 157 (in part); Bruner, 1890, Fig. (in part) 48; Schaeffer, 1928, p. 43 (in part); Essig, 1929, p. 472, Fig. 380.
Lina lapponica, McCracken, 1905, p. 117, Pl. 1, Figs. 1-6, 1906, p. 321.

Lina scripta maculicollis Schaeffer (not *Chrysomela maculicollis* Boisduval, 1835), 1928, p. 44 [type: Beaver Creek, Beaver Co., Utah; U. S. National Museum].
Chrysomela lineatopunctata, Beller and Hatch, 1932, p. 99 (in part).

Adult.—Length of males, 6.5 to 7.3 mm.; of females, 6.1 to 8.1 mm. Less elongate than *scripta*, the width from 54 to 58 per cent as great as the length; moderately convex as in *scripta*.

Dark parts blackish, with a blue or blue-green cast; this lustre usually very strong, always distinct except on the elytral spots of some specimens. Head dark; antennae usually entirely dark, sometimes with the intermediate segments rufescent or, rarely, pale. Area between the pronotal sulci usually entirely dark, rarely partly pale; in the palest specimens, only a spot on each side and another before the scutellum dark; pronotal sides pale, each with a spot which is never expanded and almost always free; the pronotum very rarely entirely dark in specimens with dark elytra.

Elytra (Fig. 35) virtually dichromatic; either entirely dark blue or blue-green, or pale and maculate; when maculate, with blackish or, usually, bluish markings much like those of *scripta;* the sutural stripe abbreviated or dilute only in the palest specimens; the spots arranged two, three, and two; the median spots less elongate than in *scripta*, the intermediate of these three and one-half or four times as long as wide; the markings rarely confluent in part, very rarely suffused over the pale areas or expanded to render the elytra almost entirely dark. Underside entirely dark except for the thorax laterally and the lateral margins of the two apical segments. Legs usually entirely dark; the tibiae occasionally rufescent at middle or, rarely, entirely pale except for infuscations basally and apically.

Sculpture throughout as in *scripta*. Pronotal sulci strongly impressed; each elytron with the lateral ridge strongly delimited internally and, in the female, with the apex distinctly produced; these characters as in *scripta*.

Geographic variation.—This concerns the frequency of the two colour forms and of the palest specimens. The inadequate material suggests that the form with maculate elytra is lacking, rare, or local in the localities of Idaho and Utah, and that the form with unicolourous elytra is lacking in Oregon. In Californian series the frequency of the forms are (some of the series may be biased): Fort Seward, Humboldt Co., 44 specimens with unicolorous elytra, 5 with maculate elytra; Redwood Creek, Humboldt Co., 12 unicolourous, 6 maculate; Lakeport, Lake Co., 7 unicolourous, 6 maculate; Sacramento, Sacramento Co., 2 unicolourous, 92 maculate; Woodacre, Marin Co., 9 unicolourous, 6 maculate; Fairfax, Marin Co., 8 unicolourous, 12 maculate; Walnut Creek, Contra Costa Co., 13 unicolourous, 8 maculate; Orinda, Contra Costa Co., 10 unicolourus, 15 maculate; Ben Lomond, Santa Cruz Co., 15 unicolourus, 10 maculate.

In all specimens with maculate elytra from Utah, the pronotum is pale except for three discal spots; the intermediate antennal segments are pale; the tibiae tend to be pale; and the median spots and sutural stripe of the elytra tend to be reduced and dilute. This is the form described as variety *maculicollis* by Schaeffer. Utah specimens with unicolourous elytra are like those from California.

Food-plants.—Salix spp.; a few specimens are labelled as from *Populus*.

Distribution.—Western Washington to central Utah and San Luis Obispo County California. The specimens seen are from:—

UTAH: American Fork Canyon, 9,500 ft.; Beaver; Beaver Canyon of Logan Canyon, Cache Co.; Beaver Creek Canyon, Beaver Co.; Beaver Creek Hills, Beaver Co.; Fort Douglas; Little Cottonwood Canyon; Mount Nebo (*Populus angustifolia* James); Mount Timponogos, 8-9,000 ft.; Nephi; Salt Lake City.

IDAHO: Boise.
NEVADA: Carson City.
WASHINGTON: Cayuse Pass, Mount Rainier National Park; Longmire (*Populus trichocarpa*); Monroe.
OREGON: Sparta.
CALIFORNIA: Redding; Blocksburg; Fort Seward; Honeydew, Humboldt Co.; Redwood and Willow Creeks, Humboldt Co.; Vina; Hopland; Willits; Clear Lake; Lakeport; Calistoga; Elkorn Ferry, Yolo Co.; Fair Oaks; Sacramento; Occidental; Santa Rosa; Winters; Davis; Cazdero (*Salix*); Forestville; Mount St. Helena; Napa; Petaluma; Sebastopol; Cordelia; Dixon; Fairfield; Green Valley, Solano Co.; Fairfax (*Salix*); Lagunitas; Mill Valley; Ross; San Anselmo; Woodacre; Oakland; Orinda (*Salix*); Mount Diable; Walnut Creek (*Salix*); Alameda; Berkeley; Hayward; Pleasanton; Sunol; Yosemite National Park; Adobe Creek; Stanislaus Co.; Belmont; Jasper Ridge, San Mateo Co.; San Andreas Lake; Alviso; Arroyo Bayo, Los Altos; Mount Hamilton (willow); Cupertino; Los Gatos; Morgan Hill; Alma; Stevens Creek (*Salix*); Palo Alto (willow); San Jose; Giant Forest, Sequoia National Park; Ben Lomond; Santa Cruz; Lomond Mountains, 2,000 ft. (*Salix*); Watsonville; Big Sur; Carmel; Jamesburg; Tassajara Hot Springs; Visalia; San Luis Obispo (*Salix*).

Notes.—*C. confluens* may be known by the blue or blue-green colour of the entire elytra or of the elytral spots. However, in some specimens the spots are black rather than blue; such specimens are scarcely separable from specimens of *semota*, which has a more northern distribution and appears to depend much more on *Populus*.

12. *Chrysomela semota* n. sp.

Adult.—Length of males, 6.8 to 7.3 mm.; of females, 7.0 to 8.3 mm. Moderately elongate and convex; the width from 54 to 58 per cent as great as the length; the form as in *confluens*.

Dark parts blackish; head and the pronotum at middle with distinct blue-green reflections; the elytral spots lacking this lustre, which is feeble on the underside and legs. Pronotum with the area between the sulci entirely dark except, usually, on each side anteriorly, very rarely largely pale (in one of the four specimens from Montana); the dark spot of each lateral area always present, always small and free. Elytra (Fig. 36) maculate as in average Californian specimens of the maculate form of *confluens;* the sutural stripe always entire; the spots very rarely (in two specimens) confluent in part. Antennae with the intermediate segments pale or rufescent. Legs dark; the tibiae usually rufescent at middle, rarely entirely dark or largely pale; trochanters and extreme bases of the femora frequently rufescent or pale. Other characters as in *confluens*.

Eggs.—Dichromatic; all eggs of each mass either pale red or deep yellow; the red eggs becoming orange before hatching.

Geographic variation.—None observed.

Food-plants.—*Salix*, *Populus balsamifera* L., and *P. trichocarpa* Torr. and Gray.

Distribution.—Southeastern British Columbia and northwestern Montana to east-central British Columbia, the Mackenzie Valley, and Great Slave Lake. The specimens seen are from:—

ALBERTA: Canmore (*Salix*), Hotchkiss (*Salix, P. balsamifera*).
BRITISH COLUMBIA: Creston, Mile 161 of the Alaska Highway (*P. trichocarpa*), Sinclair Mills (*P. trichocarpa*), Squilax, Taft (*P. trichocarpa, Salix*), Ymir (*P. trichocarpa*).
NORTHWEST TERRITORIES: Fort Simpson, Hay River (*Salix*), Norman Wells (*Salix, P. balsamifera*), Wrigley.
MONTANA: Glacier National Park (*P. trichocarpa*).

Holotype, ♂; *allotype*, ♀; 5 ♂, 5 ♀ *paratypes*.—Norman Wells, Northwest Territories, July 1, 1949 (W. R. M. Mason), on *Populus balsamifera* L.; 60 ♂,

88 ♀ *paratypes*.–Same locality, collected from or reared from eggs or larvae on *Salix* and *P. balsamifera*, 1949 (S. D. Hicks and W. R. M. Mason); No. 6164 in the Canadian National Collection, Ottawa.

Notes.–*C. semota* is very common about Great Slave Lake and on the Mackenzie River. The specimens show little variation and are virtually inseparable from specimens of *confluens* that have the elytra maculate and the elytral spots without a bluish lustre.

13. *Chrysomela lineatopunctata* Forster

Chrysomela lineato-punctata Forster, 1771, p. 22 [type: New York]; in the sense (in part) of Beller and Hatch, 1932, p. 99.
Melasoma lineatopunctata, Gemminger and Harold, 1874, p. 3411 (in part); Weise, 1916, p. 142 (in part).
Chrysomela noveboracensis Gmelin, 1790, p. 1689 [proposed as a substitute for *C. lineatopunctata* Forster].
Chrysomela variegata Olivier, 1790, p. 719 [proposed as a substitute for *C. lineatopunctata* Forster].
Helodes obsoleta Say, 1824, p. 453 [type: "Missouri"]; LeConte, 1859, p. 218. *New synonymy*.
Chrysomela obsoleta, Rogers, 1856, p. 37; Suffrian, 1858, p. 391; LeConte, 1859, p. 218; Wilcox, 1954, p. 422.
Plagiodera obsoleta, Stål, 1865, p. 332; Crotch, 1873, p. 53.
Melasoma obsoleta, Gemminger and Harold, 1874, p. 3412; Schaeffer, 1920, p. 331.
Lina obsoleta, Henshaw, 1885, p. 110; Blatchley, 1910, p. 1161; Schaeffer, 1928, p. 44.
Plagiodera scripta, in the sense (in part) of Crotch, 1873, p. 53, and of Riley, 1880, p. 161.
Lina scripta, in the sense (in part) of Packard, 1890, p. 432, Fig. 157; Lowe, 1898, pp. 1-20, Pls. 1-6; Chagnon, 1938a, p. 17 (in part), 1938b, p. 305 (in part).
Lina obsoleta scriptoides Schaeffer, 1928, p. 44 [type: West Point, New York; U.S. National Museum].
Lina sp., Bruner, 1890, p. 92, Fig. 65.

Adult.–Length of males, 5.9 to 6.4 mm.; of females, 6.4 to 7.9 mm. Less elongate and more strongly convex than similarly maculate species, these differences distinct when series are compared; the width from 57 to 59 per cent as great as the length.

Dark parts blackish; except for those of the elytra, usually with greenish reflections; the maculation varying greatly both individually and geographically. Elytra (Figs. 37-38) usually pale and maculate; the spots of each then two, three, and two as in allied species; the intermediate of the median spots between four and five and one-half times as long as wide; a small additional spot frequently present at the middle of the extreme base; the spots rarely lacking in part, sometimes confluent in part; the elytra sometimes almost entirely dark.

Sculpture throughout as in *scripta*. Pronotal sulci strongly impressed; each elytron with the lateral ridge strongly delimited internally and, in the female, with the apex produced; these characters as in *scripta*.

Eggs (from the Ottawa district).–Polychromatic; all eggs of each mass pink, deep yellow, or rarely pale green; pink masses about three times as numerous as yellow masses.

Geographic variation.–This concerns the maculation. The palest series are from the prairies of southern Alberta; in the East, the series darken from south to north.

Palest series (from Waterton Lake to Lethbridge, Alta.).–Head entirely pale or with a median dark spot at base; the spot usually small, never attaining the eyes, sometimes divided on the median line; each antenna with four or five apical segments dark, entirely pale basally. Pronotum frequently entirely pale, usually with a small median spot on each lateral area and with from two to five spots between the sulci; these discal spots usually subequal to the sublateral spots,

rarely enlarged or fused to form an M-shaped mark. Elytra always with discrete spots; the spots averaging smaller than in eastern specimens, frequently greatly reduced in size, sometimes lacking in part; the sutural stripe usually abbreviated anteriorly, obsolete, or entirely lacking. Underside and legs sometimes entirely pale; usually with the metasternum and two or three abdominal segments largely dark; the darkest specimens with the abdomen, except for the margins, and a small median spot on each femur dark.

Typical series (from New York, the eastern states generally, and from Manitoba).—Head very rarely entirely pale, occasionally largely or entirely dark, usually with a basal dark spot which frequently attains the eyes; antennae with the intermediate and basal segments nearly always more or less darkened. Pronotum very rarely entirely pale; usually with a small spot on each lateral area, and with five discal spots, which are often more or less fused, tending to form an M-shaped mark. Elytra usually with discrete spots, the sutural stripe then entire or virtually so; frequently with the spots more or less fused; frequently entirely dark except for the lateral ridges and, usually, one or more pale streaks. Underside rarely entirely pale, usually with the metasternum and abdomen partly or almost entirely dark. Legs usually entirely pale; the femora sometimes darkened at middle; in topotypical specimens the femora frequently almost entirely dark and the tarsi and outer margins of the tibiae infuscate.

Darker series (from eastern Ontario).—Rarely as pale as average specimens of the typical series described above; usually with the head and with the pronotum between the sulci entirely dark. Elytra sometimes darkened by suffusions between the spots, the lateral ridges then becoming dark; the spots sometimes more or less confluent. Underside rarely entirely pale, usually entirely dark except for the lateral areas of the prothorax and the margins of two or three apical segments. Legs varying from entirely pale to entirely dark.

Other series.—Series from southernmost Quebec are intermediate between the typical series and the series from eastern Ontario. Specimens from Fort Smith, N.W.T., resemble average specimens of the Ontario series but show a stronger tendency for the elytra to become darkened by suffusion.

Food-plants.—These are species of *Salix* and *Populus*. In eastern Canada, populous colonies occur only on small willows growing in marshes. The species breeds rather commonly on tender leaves of *P. balsamifera* L. and rarely on *P. tremuloides* Michx. and *P. grandidentata* Michx.

Distribution.—Southernmost Quebec, central Ontario, northern Manitoba, northernmost Alberta (Fort Smith, N.W.T.), and central British Columbia to northernmost New Jersey, Ohio, and Illinois, and to south-central Colorado. The specimens seen are from:—

QUEBEC: Abbotsford, Brome (*Salix*, *P. tremuloides*), Knowlton, Lanoraie, Montreal, St. Hilaire.
ONTARIO: Arnprior (*Salix*, *P. tremuloides*, *P. grandidentata*, *P. balsamifera*), Blackburn (*P. tremuloides*), Chapleau (*Populus*), Eastview (*Salix*), Galt (*Salix*), Go Home, Marmora (*Salix*, *P. balsamifera*), Merivale (*Salix*), Miners Bay (*Salix*), Oba (*Salix*), Ottawa (*Salix*), Peterbell (*Salix*), Port Rowan (*Salix*), Roebuck (*Salix*), Simcoe (*Populus*), Spencerville (*P. tremuloides*).
MANITOBA: Aweme, Brandon, Gillam (*Salix*), Mile 332 of the Hudson Bay Railway, Winnipeg.
ALBERTA: Banff, Barnwell, Blackfalds, Edmonton, Kimball, Lethbridge (*S. amygdaloides*), Macleod (*S. amygdaloides*), Nordegg, Red Deer, Waterton Park (*S. amygdaloides*).
BRITISH COLUMBIA: Blue River, Hansard, Jesmond, Yoho National Park.
NORTHWEST TERRITORIES: Fort Smith (*P. tremuloides*).
MAINE: Milford.
NEW HAMPSHIRE: Claremont, Durham, Manchester.

MASSACHUSETTS: Boston, Cummington, Framingham (*Populus*), Humarock, Haverhill, Little Deer River (*P. tremuloides*), Lowell, Milton, Natick (*Salix*), Sherborn (*Salix*), Springfield, Tyngsboro, Wellesley, Wilbraham.
VERMONT: Battleboro.
NEW YORK: West Point.
NEW JERSEY: Green Village, Hewitt.
OHIO: Lucas Co.
MICHIGAN: Detroit, Whitefish Point.
WISCONSIN: Beaver Dam, Madison.
ILLINOIS: Chicago.
MINNESOTA: Duluth, Euclid, Mora.
IOWA: Iowa City.
NEBRASKA: Holt Co.
COLORADO: Bellvue, Gunnison Co. (8,000 ft.), Platte Canyon, Poudre River, Veta Pass.
MONTANA: Columbia Falls, Gallatin Co. (4,700 ft.), Kalispell, Yellowstone National Park.
IDAHO: Pocatello.

Notes.—In *lineatopunctata* the body is less elongate and more convex than in other species that are similarly maculate.

Some authors have confused the present species with *scripta*. New York specimens of the latter do not satisfy the original description of *lineatopunctata*. The type of *lineatopunctata*, which came from New York, was described as having the head bicoloured, the pronotum pale and with dark discal spots, the abdomen dark, and the legs pale except for the femora at middle. Many New York specimens of the present species agree with this description.

14. *Chrysomela texana* (Schaeffer)

Plagiodera scripta, Riley, 1880, p. 161 (in part).
Lina scripta, Packard, 1890, p. 432 (in part).
Melasoma scripta texana Schaeffer, 1920, p. 331 [cotypes: Brownsville and New Braunfels, Texas; U.S. National Museum].
Lina scripta texana, Schaeffer, 1928, p. 44.

Adult.—Length of males, 6.3 to 8.0 mm.; of females, 7.9 to 8.8 mm. Moderately elongate and convex; the width from 55 to 59 per cent as great as the length; the form less elongate than in *scripta*, as in *confluens* and *semota*.

Entirely pale or virtually so except for the antennal apices and elytral spots. Head, antennae except for four or five apical segments of each, pronotum, underside, legs, and sometimes the lateral ridge and sutural margin of each elytron reddish-yellow; the tarsi darker; feebly infuscate areas with greenish reflections sometimes present on the pronotal disk, metasternum, and abdominal segments. Elytra (Fig. 39) dull yellow, with blackish spots which are arranged two, three, and two as in allied species; the spots never confluent, the intermediate of the median spots from three to five times as long as wide; the sutural stripe rarely entire, usually virtually lacking or obsolete and dilute, always evident on the apical declivity and often with an appendage there which is sometimes disjoined to form a small spot.

Coarse punctures of the pronotum nearly always more numerous, the sculpture otherwise as in *scripta*. Pronotal sulci strongly impressed and the lateral ridge of each elytron strongly delimited internally as in *scripta*; the elytral apices of the female not produced but more strongly acute than in the male.

Geographic variation.—None observed.

Food-plant.—Evidently *Salix*.

Distribution.—Known only from central and southern Texas. The specimens seen are from:—

TEXAS: Brownsville (*Salix*), College Station, Devils River, El Campo, Hays Co., Hidalgo, Hondo, La Blanca, Laredo, Mercedes, Mission (*Salix*), New Braunfels, Round Mountain, San Antonio, Victoria (under bark of willow, Feb. 29), Zavalla Co.

Note.—This species is characterized by its extremely pale colour, which is matched only in some prairie specimens of the northern *lineatopunctata*.

15. *Chrysomela mexicana* n. n.

Chrysomela depressa Suffrian (not *Chrysomela depressa* Fairmaire, 1854), 1858, p. 390 [cotypes: Mexico].
Plagiodera depressa, Stål, 1865, p. 295.
Melasoma depressa, Gemminger and Harold, 1874, p. 3411.
Lina depressa, Jacoby, 1882, p. 194, 1891, p. 244, Pl. 10, Fig. 3.

Adult.—Length of males (three specimens), 6.2 to 6.6 mm.; of females (eight specimens), 7.0 to 7.8 mm. Moderately elongate and convex; the width from 54 to 57 per cent as great as the length; the form as in *texana* and *confluens*.

Darker parts pale to dark reddish-brown; the head and thorax, in the darker specimens, with greenish reflections. Head and thorax entirely reddish-brown; each antenna with four or five apical segments almost black. Elytra sometimes entirely reddish-brown like the anterior parts; sometimes dull yellow and with a sutural stripe, each lateral ridge, and spots reddish-brown; the spots arranged two, three, and two as in allied species, the intermediate of the median spots four to five times as long as wide; the markings often more or less confluent, sometimes almost completely so. Underside and legs sometimes reddish-yellow; sometimes with the metasternum, partly or largely, and the tarsi reddish-brown.

Head and pronotum variably punctate; the punctures of the head moderately coarse and close; those of the pronotum coarse, usually at least moderately close at middle and dense on the sides; elytra coarsely punctate, the punctures irregularly distributed, very close and usually confluent in part; the entire dorsum more coarsely and closely punctate than in *texana* and *scripta*. Pronotal sulci feebly impressed or obsolete; the lateral ridge of each elytron strongly delimited internally; the elytral apices of the female not produced but more strongly acute than in the male.

Geographic variation.—None observed.

Food-plant.—Unknown.

Distribution.—Central Mexico to Guatemala; reported from British Honduras by Jacoby (1891, p. 244). The specimens seen are from:—
MEXICO: Jalapa, Orizaba, Tamazunchale, Teapa.
GUATEMALA: San Geronimo.

Note.—This species is strongly characterized by the colour, feebly impressed pronotal sulci, and by the coarse, close puncturation of the dorsum.

16. *Chrysomela cruentipennis* (Jacquelin du Val)

Lina cruentipennis Jacquelin du Val, 1856, p. 125, Pl. 11, Fig. 7 [cotypes: Cuba], 1857, p. 303.
Plagiodera cruentipennis, Stål, 1865, p. 295.
Chrysomela cruentipennis, Suffrian, 1867, p. 299.
Melasoma cruentipennis, Gemminger and Harold, 1874, p. 3411.

Adult.—Length of males, 6.1 to 7.1 mm.; of females, 7.1 to 8.0 mm. Elongate-oval, the width from 53 to 55 per cent as great as the length; only moderately convex; the form as in *scripta* and *laurentia*.

Dark parts deep blue-green, the metallic lustre stronger on the dorsal parts than on the underside and legs; the pale areas reddish-yellow throughout. Head dark; each antenna with the five apical segments black, the other segments usually more or less dilute, or pale beneath. Pronotum with the area between the sulci usually entirely dark, sometimes rufescent anteriorly and on each side of the median line posteriorly; each lateral area with a median dark spot; the spot usually attached to the dark discal area, sometimes expanded to render the lateral area partly or, rarely, almost entirely dark. The pale discal parts of the elytra

never dull yellow as in allied species; the spots of each elytron (Fig. 40) arranged two, three, and two as in allied species, very rarely discrete, nearly always fused in part in a unique manner; the basal spots frequently joined basally; the subapical spots nearly always completely fused except anteriorly, nearly always joined to the suture and occasionally to the internal of the median spots, which are otherwise discrete; the intermediate of the median spots from four to five times as long as wide; sometimes with a sutural stripe which is rarely entire, usually abbreviated basally or obsolete. Underside sometimes entirely dark except for the sides of the thorax and the margins of two or three apical segments; usually with the intercoxal parts and the outer margins of the entire abdomen pale or rufescent. Legs entirely dark or, rarely, with the trochanters and the femoral bases pale.

Sculpture throughout as in *scripta*. Pronotal sulci strongly impressed and the external ridge of each elytron strongly delimited internally as in *scripta*; the elytral apices of the female more strongly produced than in allied species.

Food-plant.—*Salix*.

Distribution.—Known only from western Cuba. The specimens seen are from:—

CUBA: Laguna Ariguanabo, province of Pinar del Rio (*Salix*); Havana.

Note.—This is the only species known from the West Indies.

17. *Chrysomela schaefferi* n. n.

Melasoma immaculata Schaeffer (not *Chrysomela immaculata* Olivier, 1790, p. 695), 1920, p. 330 [cotypes: Washington State; U.S. National Museum].
Lina immaculata, Schaeffer, 1928, p. 45.
Chrysomela immaculata, Beller and Hatch, 1932, p. 97.

Adult.—Length of males, 3.9 to 5.8 mm.; of females, 5.0 to 6.5 mm. Broadly oval, the width from 60 to 63 per cent as great as the length; moderately convex.

Dark parts blackish, bronzed on the dorsum; the pale areas pale red throughout. Head dark; each antenna with the basal and four or five apical segments dark, the other segments pale. Pronotum variable; the area between the sulci always dark; each lateral area always pale and with a free median spot in specimens with pale elytra; the spot sometimes attached to the dark discal area and rarely expanded to render the area largely or entirely dark in specimens with dark elytra. Elytra dichromatic, entirely dark or entirely pale. Underside sometimes almost entirely dark, sometimes largely pale. Legs sometimes entirely pale, usually with the apical halves of the femora and the bases of the tibiae dark.

Head and pronotum punctate as in *scripta;* punctures of the elytra finer than in *scripta* and its allies. Pronotal sulci strongly impressed. Lateral ridge of each elytron not abruptly delimited internally as in *scripta* and allies, not distinctly delimited except in the posthumeral region; the elytral apices of the female scarcely produced but more strongly acute than in the male.

Geographic variation.—In the 170 specimens from Manitoba, which are from a single colony, the size averages distinctly smaller and the legs considerably paler than in specimens from other regions. All of the fifteen specimens with the pronotum entirely dark are from the series taken in east-central and southernmost British Columbia and at Banff, Alta. All specimens from Canada, except some from southernmost British Columbia and one from Banff, have the elytra dark. All specimens from western Washington have the elytra pale. In many of the Californian series, both dark and pale elytra occur; it is difficult to evaluate these series, because many of the specimens are teneral.

Food-plant.—*Salix*.

Distribution.—Northeastern Manitoba; east-central Alaska to the mountains

of southwestern Alberta and to Eldorado and San Luis Obispo Counties, California. The specimens seen are from:—

MANITOBA: Gillam (*Salix*).

ALBERTA: Banff, Coleman (*Salix*), Crowsnest Pass (*Salix*), Hinton (*Salix*), Jasper National Park, Jumping Pound (*Salix*), Kananaskis (*Salix*), Maycroft (*Salix*), Seebe (*Salix*), Waterton Lakes (*Salix*).

BRITISH COLUMBIA: Agassiz, Barkerville (4,200 ft., *Salix*), Blue River, Creston (*Salix*), Clinton (*Salix*), Copper Mountain, Goldstream, Hansard, Kaslo, Pennask Lake (*Salix*), Robson, Saanich, Stanley, Vancouver, Victoria, Wynndel (*Salix*), Yoho National Park.

YUKON TERRITORY: Big Salmon, Fort Selkirk, Hootalinqua, Whitehorse.

ALASKA: Eagle.

WASHINGTON: Everett, North Bend, Seattle.

OREGON: McMinnville.

CALIFORNIA: McCloud, Blocksburg, Fort Seward, Carrville, Coffee, Caribou, Meadow Valley (3,500 ft.), Quincy, Chico, Pulga, Yorkville, Nevada City (*Salix*), Comptonville (*Salix*), Adams, Clearlake, Placer Co., Camino, Pilot Hill, Placerville, Cazadero, Forestville, Mount St. Helena, Santa Rosa, Sebastopol, Napa Co., Cordelia, Inverness, Lagunitas, Mill Valley, Mount Tamalpais, Ross, San Anselmo, Stinson Beach (*Salix*), Woodacre, Lafayette Moraga, Mokelumne River, Berkeley, Oakland, Belmont, San Andreas, Alameda, Yosemite Valley, Los Gatos, Ben Lomond, Santa Cruz, Soquel, Watsonville, Ahwahnee, Big Sur, Carmel, Monterey, Pacific Grove, Paraiso Springs, Morro Bay, Oceano, San Luis Obispo.

Note.—This species is characterized by the small size and by the poorly delimited lateral ridge of each elytron.

18. *Chrysomela blaisdelli* (Van Dyke), n. comb.

Chrysolina blaisdelli Van Dyke, 1938, p. 48 [type: Nome, Alaska; California Academy of Sciences, San Francisco].

Adult.—Differing from *engelhardti* by colour only. Length of the male holotype, 5.0 mm.; of one female from the Norman Range, 7.2 mm. Body entirely blackish except for the lateral areas of the prothorax, which are red except for a spot on each; the dorsum, except for the red pronotal areas, metallic, brassy in the holotype, bluish in the other specimen. Legs red; the tarsi darker; the extreme apices of the femora and bases of the tibiae infuscate in the holotype.

Holotype with the elytral striae and their punctures fairly regular except laterally; intervals three, five, and seven a trifle more convex than the others and virtually impunctate; the sculpture much as in many specimens of *engelhardti*. The other specimen with the punctures completely confused as in the non-striate species and with the intervals moderately and equally convex.

Food-plant.—Unknown, probably *Salix*.

Distribution.—Western Alaska to the Mackenzie River and to an unknown distance eastward. The five known specimens are from:—

NORTHWEST TERRITORIES: Northeast of Norman Wells in the Norman Range of the Franklin Mountains, 2,500 ft.; Richardson Mountains, near Aklavik, 2,000 ft.

ALASKA: Nome.

Notes.—This is a species of the tundra. Van Dyke reported two paratypes from Aklavik, N.W.T. These were taken by Owen Bryant, one at an elevation of 2,000 feet. Bryant lived and collected a few miles west of Aklavik at the base of the Richardson Mountains. The species probably does not occur at Aklavik or in other parts of the Mackenzie Delta.

This species and *engelhardti* differ strikingly from all others as noted in the description of the latter.

19. *Chrysomela engelhardti* (Hatch), n. comb.

Chrysolina engelhardti Hatch, 1939, p. 49 [type: Mount McKinley National Park, Alaska; Hatch Collection, Seattle, Washington].

Adult.—Length of males (four specimens), 4.9 to 5.1 mm.; of females (20 specimens), 5.7 to 6.3 mm. Short and robust; more convex than any other species except *blaisdelli;* the width from 60 to 64 per cent as great as the length.

Body entirely black, without metallic lustre; antennae black, the intermediate segments usually rufescent; the femora and tibiae varying from pale reddish-brown to dark brown, the femoral bases and trochanters always pale or rufescent; the tarsi blackish.

Eyes smaller and much less convex than in any other species except *blaisdelli.* Pronotum with the sulci strong posteriorly but sometimes feebly impressed anteriorly. Sculpture, except for that of the elytra, as in the other species; the elytra transversely rugulose, striate; the striae well defined in part at least, they and their punctures frequently somewhat irregular; intervals three, five, and seven usually more convex than the others, usually largely impunctate, the others with very sparse to moderately close punctures which are coarse like those of the striae; the lateral ridge of each elytron rather feebly delimited internally; the elytral apices of the female distinctly produced and much more strongly acute than in the male.

Food-Plant.—Salix.

Distribution.—Known only from Mount McKinley National Park, Alaska, and Eskimo Point (lat. 61° 15′, long. 94° 10′), Northwest Territories.

Notes.—The above description is based on specimens reared from larvae that were found as a single colony on decumbent willows growing on tundra at Eskimo Point. Dr. Melville H. Hatch has compared a specimen with the type, which he described as being 6.75 mm. in length. The species is very closely allied to *blaisdelli.*

REFERENCES

Beller, S., and M. H. Hatch. 1932. Coleoptera of Washington: Chrysomelidae. *Univ. Washington Pub. Biol.* 1: 65-144.

Blake, D. H. 1952. American Chrysomelidae in the Bosc Collection. *Proc. Ent. Soc. Washington* 54: 57-68.

Blatchley, W. S. 1910. Coleoptera or beetles known to occur in Indiana. The Nature Publishing Co., Indianapolis.

Blatchley, W. S. 1924. The Chrysomelidae of Florida (Part 3). *Florida Ent.* 8: 1-7.

Boisduval, J. A. 1835. Faune entomologique de l'Océanie. Librairie Encyclopédique de Roret, Paris.

Bruner, L. 1890. Insects injurious to young trees on tree claims. *Univ. Nebraska Agr. Expt. Sta. Bull.* 14: 83-149.

Chagnon, G. 1938a. Contribution à l'étude des coléoptères de la province de Québec. *Nat. Canadien* 65: 13-23.

Chagnon, G. 1938b. Contribution à l'étude des coléoptères de la province de Québec. 5: polyphages (suite). Le Naturaliste Canadien, Quebec.

Chen, S. H. 1935. Recherches sur le Chrysomelinae de la Chine et du Tonkin. *Ann. Soc. Ent. France* 104: 127-158.

Crotch, G. R. 1873. Materials for the study of the Phytophaga of the United States. *Proc. Acad. Nat. Sci. Philadelphia* 25: 19-83.

Cushman, R. A. 1917. Notes on the biology of *Schizonotus sieboldi* Ratz. *Proc. Ent. Soc. Washington* 19: 128-129.

Davis, W. T. 1920. Notes on beetles of the genera *Melasoma* and *Gonioctena. Bull. Brooklyn Ent. Soc.* 15: 145-146.

Dowden, P. B. 1939. *Schizonotus sieboldi,* an important parasite of the imported willow leaf beetle (*Plagiodera versicolora*). *J. Agr. Res.* 58: 581-592.

Essig, E. O. 1929. Insects of western North America. The Macmillan Co., New York.

Fabricius, J. C. 1781. Species insectorum. 1. C. E. Bohn, Hamburgi et Kilonii.

Fabricius, J. C. 1801. Systema eleutheratorum. 1. Impensis Bibliopolii Academici Novi, Kiliae.

Felt, E. P. 1906. Insects affecting park and woodland trees. *New York State Mus. Mem.* 8(2): 333-877.

Forster, J. R. 1771. Novae species insectorum, centuria 1. B. White, London.

Gemminger, M., and E. von Harold. 1874. Catalogus Coleopterorum hucusque descriptorum synonymicus et systematicus. Chrysomelidae I. 11. E. H. Gumm, Munich.

Gmelin, J. F. 1790. Systema naturae. Tome 1, pars 4. Beer, Lipsiae.

Hamilton, J. 1889. Catalogue of the Coleoptera common to North America, northern Asia and Europe, with distribution and bibliography. *Trans. American Ent. Soc.* 16: 88-162.

Hamilton, J. 1894. Catalogue of the Coleoptera common to North America, northern Asia and Europe, with distribution and bibliography; second edition. *Trans. American Ent. Soc.* 21: 345-416.

Hatch, M. H. 1939. List of the Coleoptera taken by Mr. George P. Engelhardt in Alaska in 1938. *Bull. Brooklyn Ent. Soc.* 34: 45-50.

Henshaw, S. 1885. List of the Coleoptera of America, north of Mexico. American Entomological Society, Philadelphia.

Hinton, H. E. 1951. On a little-known protective device of some chrysomelid pupae. *Proc. Roy. Ent. Soc. London (A)* 26: 67-73.

Jacoby, M. 1880-1892. Biologia Centrali-Americana. Insecta. Coleoptera, 6(1). Phytophaga (part).

Jacoby, M. 1888-1892. Biologia Centrali-Americana. Insecta. Coleoptera, 6(1, suppl.). Phytophaga (part).

Jacquelin du Val, P. N. C. 1856. Coleoptera. *In* Historia fisica, politica y natural de la Isla de Cuba; Secunda Parte: Historia natural, by Ramon de la Sagra. Vol. 7. Arthus Bertrand, Paris.

Jacquelin du Val, P. N. C. 1857. Coleoptera. *In* Histoire physique, politique et naturelle de l'Isle de Cuba; animaux articulés, a pied articulés, by Ramon de la Sagra. Arthus Bertrand, Paris.

Knab, F. 1911. (In proceedings of the meeting) *Proc. Ent. Soc. Washington* 13: 12.

LeConte, J. L. 1859. The complete writings of Thomas Say on the entomology of North America. 2. Baillière Brothers, New York.

Leng, C. W. 1919. Family Chrysomelidae. *In* Report of the Canadian arctic expedition 1913-18, 3E. King's Printer, Ottawa.

Leng, C. W. 1920. Catalogue of the Coleoptera of America, north of Mexico. John D. Sherman, Jr., Mount Vernon, New York.

Lipp, H. 1935. Die Lebenweise von *Melasoma aenea* (L.) in der Mark. *Deutsche ent. Zeit.*, pp. 1-64.

Lowe, V. H. 1898. Cottonwood leaf beetle. *New York Agr. Expt. Sta. (Geneva) Bull.* 143: 1-20.

Lugger, O. 1889. Insects affecting poplars and willows. *Univ. Minnesota Agr. Expt. Sta. Bull.* 9: 48-64.

McCracken, I. 1905. A study of the inheritance of dichromatism in *Lina lapponica*. *J. Expt. Zool.* 2: 116-136.

McCracken, I. 1906. Inheritance of dichromatism in *Lina* and *Gastroidea*. *J. Expt. Zool* 3: 321-336.

McCracken, I. 1907. Occurrence of a sport in *Melasoma* (*Lina*) *scripta* and its behavior in heredity. *J. Expt. Zool.* 4: 221-238.

Mannerheim, C. G. 1853. Dritter Nachtrag zur Kaefer-Fauna der nord-amerikanischen Laender des russischen Reiches. *Bull. Soc. Imp. Nat. Moscou* 26: 95-273.

Maulik, S. 1925. Note on the nomenclature of the coleopterous genera *Chrysomela*, L., and *Melasoma*, Steph. *Ann. Mag. Nat. Hist.* 25: 95-96.

Melsheimer, F. E. 1853. Catalogue of the described Coleoptera of the United States. Revised by S. S. Haldeman and J. L. LeConte. Smithsonian Institution, Washington.

Olivier, A. G. 1790. Encyclopedie méthodique. 5. Chez Panckoucke, Paris.

Olivier, A. G. 1807. Entomologie. 5. Chez Desray, Paris.

Philippi, R. A., and F. Philippi. 1864. Beschreibung einiger neuen chilenischen Käfer. *Stettin Ent. Zeit.* 25: 266-284, 313-406.

Packard, A. S. 1890. Fifth report of the United States Entomological Commission . . . insects injurious to shade trees. Government Printing Office, Washington.

Riley, C. V. 1880. A foe to cottonwood, the streaked cottonwood beetle. *American Ent.* 3: 159-161.

Riley, C. V. 1890. General notes; Entomological Society of Washington. *Insect Life* 3: 430-432.

Rogers, W. F. 1856. Synopsis of species of *Chrysomela* and other genera inhabiting the United States. *Proc. Acad. Nat. Sci. Philadelphia* 8: 29-39.

Say, T. 1824. Descriptions of coleopterous insects collected in the late expedition to the Rocky Mountains. *J. Acad. Nat. Sci. Philadelphia* 3: 403-462.

Schaeffer, C. 1920. Synonymical and other notes on some species of the family Chrysomelidae and descriptions of new species. *J. New York Ent. Soc.* 27: 307-340 (1919).

Schaeffer, C. 1928. Notes on the species of *Lina* and allied genera. *Canadian Ent.* 60: 42-47.

Schaeffer, C. 1934. Short studies in the Chrysomelidae. *J. New York Ent. Soc.* 41: 457-480 (1933).

Stål, C. 1865. Monographie des chrysomélides de l'Amerique, III. *Nova acta roy. soc. sci. Upsal* 4: 177-365.

Suffrian, E. 1858. Uebersicht der in den Verein. Staaten von Nord-Amerika einheimischen chrysomelen. *Ent. Ztg. Stettin* 19: 237-278, 381-400.

Van Dyke, E. C. 1938. A review of the genus *Chrysolina* Motschulsky in North America. *Bull. Brooklyn Ent. Soc.* 33: 45-58.

Walsh, B. D. 1864. On phytophagic varieties and phytophagic species. *Proc. Ent. Soc. Philadelphia* 3: 403-430.

Weise, J. 1915. Ubersicht der Chrysomelini. *Deutsche ent. Zeit.*, pp. 434-436.

Weise, J. 1916. Coleopterorum catalogus. 68, Chrysomelinae. W. Junk, Berlin.

Wilcox, J. A. 1954. Leaf beetles of Ohio (Chrysomelidae: Coleoptera). *Ohio Biol. Survey Bull.* 43 (8: 353-506).

Woods, W. C. 1918. The biology of Maine species of *Altica*. *Maine Agr. Expt. Sta. Bull.* 273: 149-204.

Woods, W. C., and H. C. Fall. 1924. The blueberry leaf-beetle and some of its relatives. *Maine Agr. Expt. Sta. Bull.* 319: 81-140.

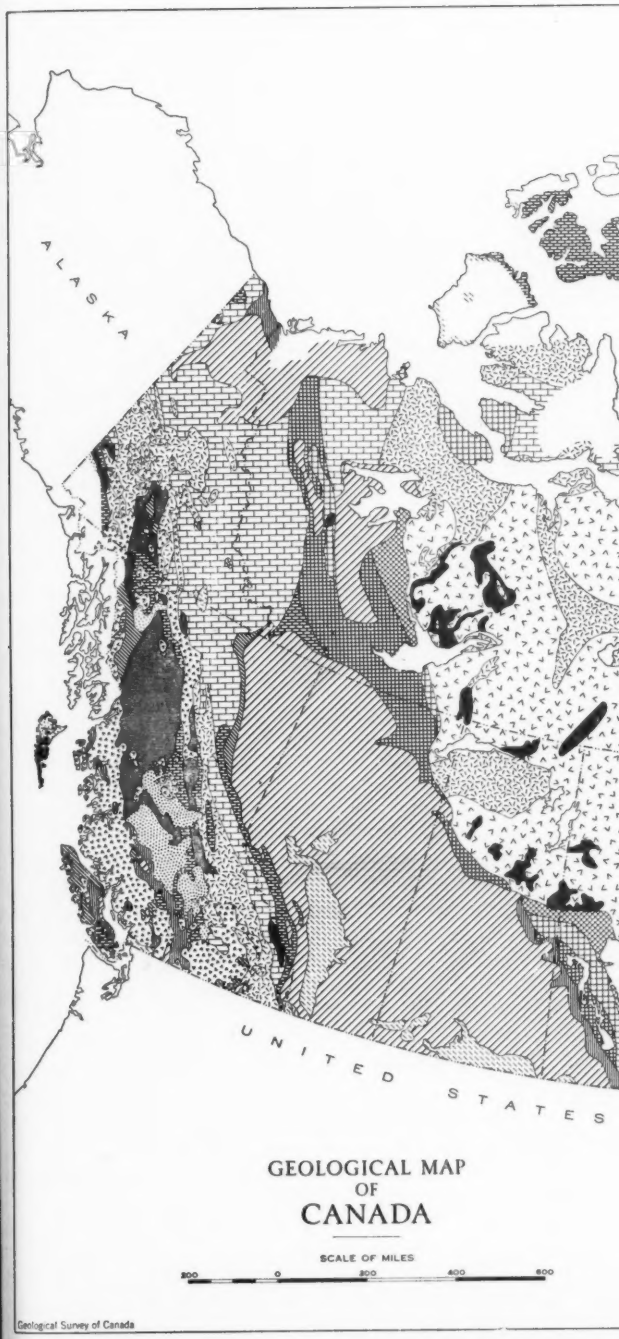
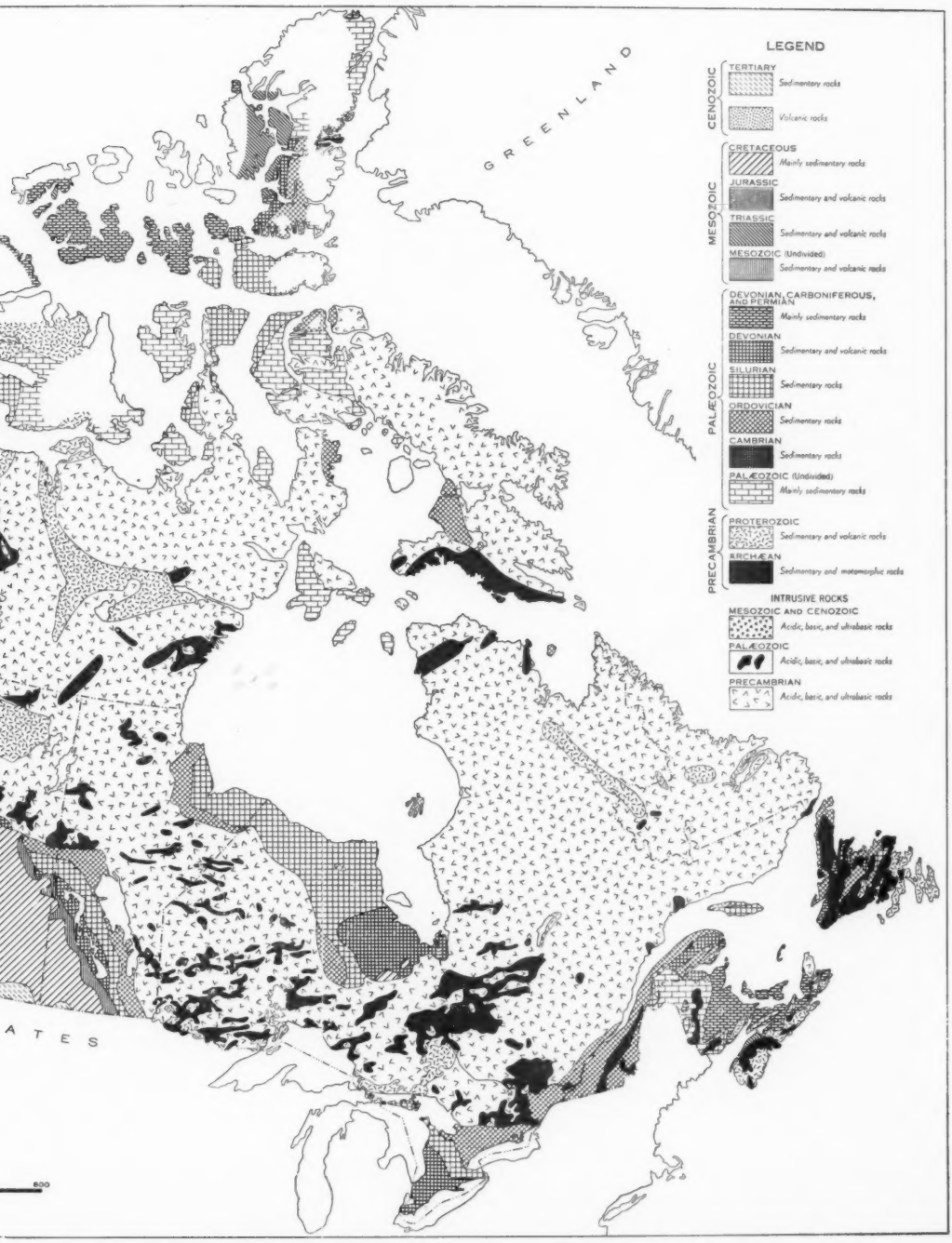


Fig. 2. Geological regions of



al regions of Canada. Reproduced by courtesy of Geological Survey of Canada.

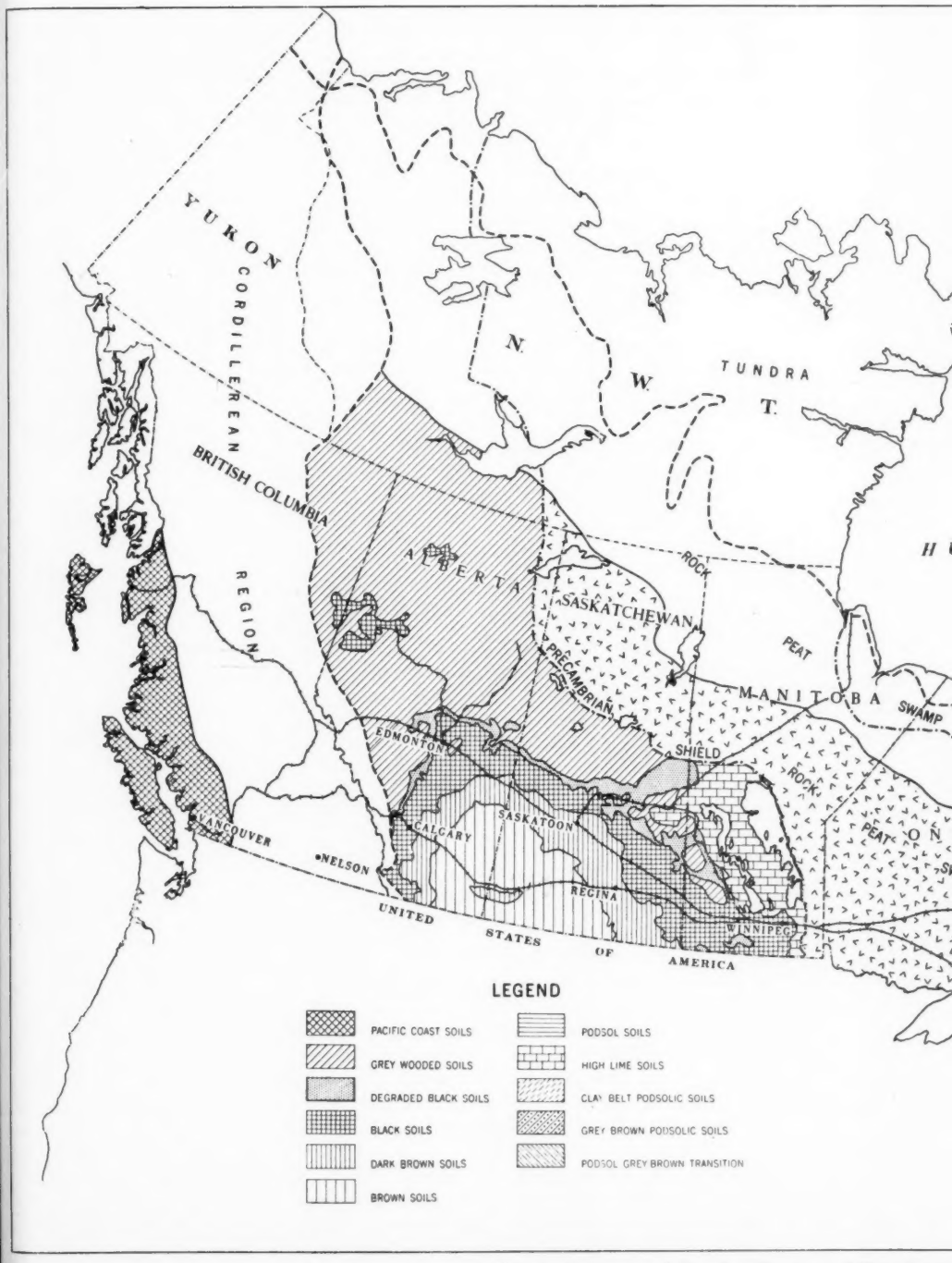
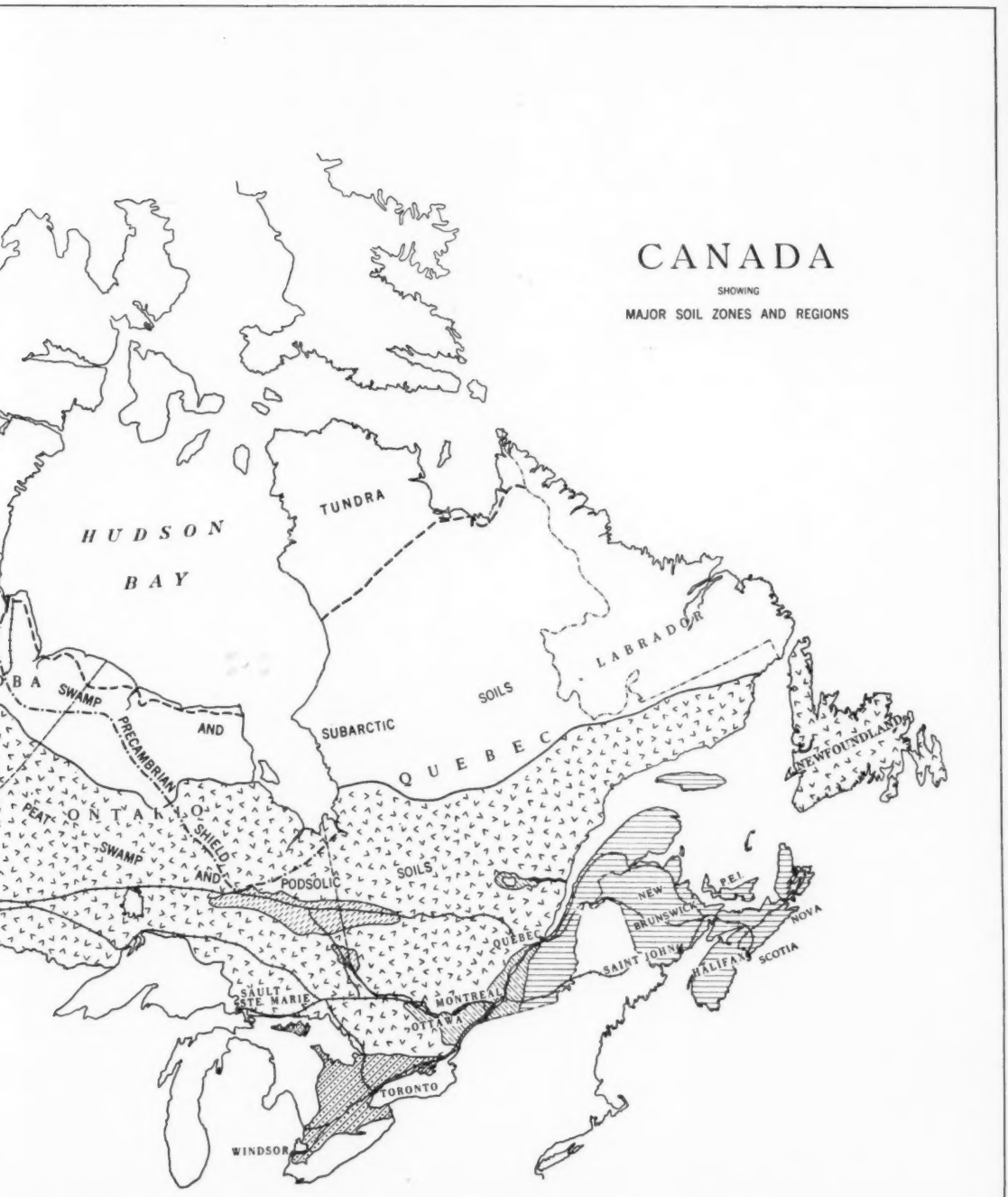


Fig. 25. Soil zones of Canada. Courtesy of Experiment

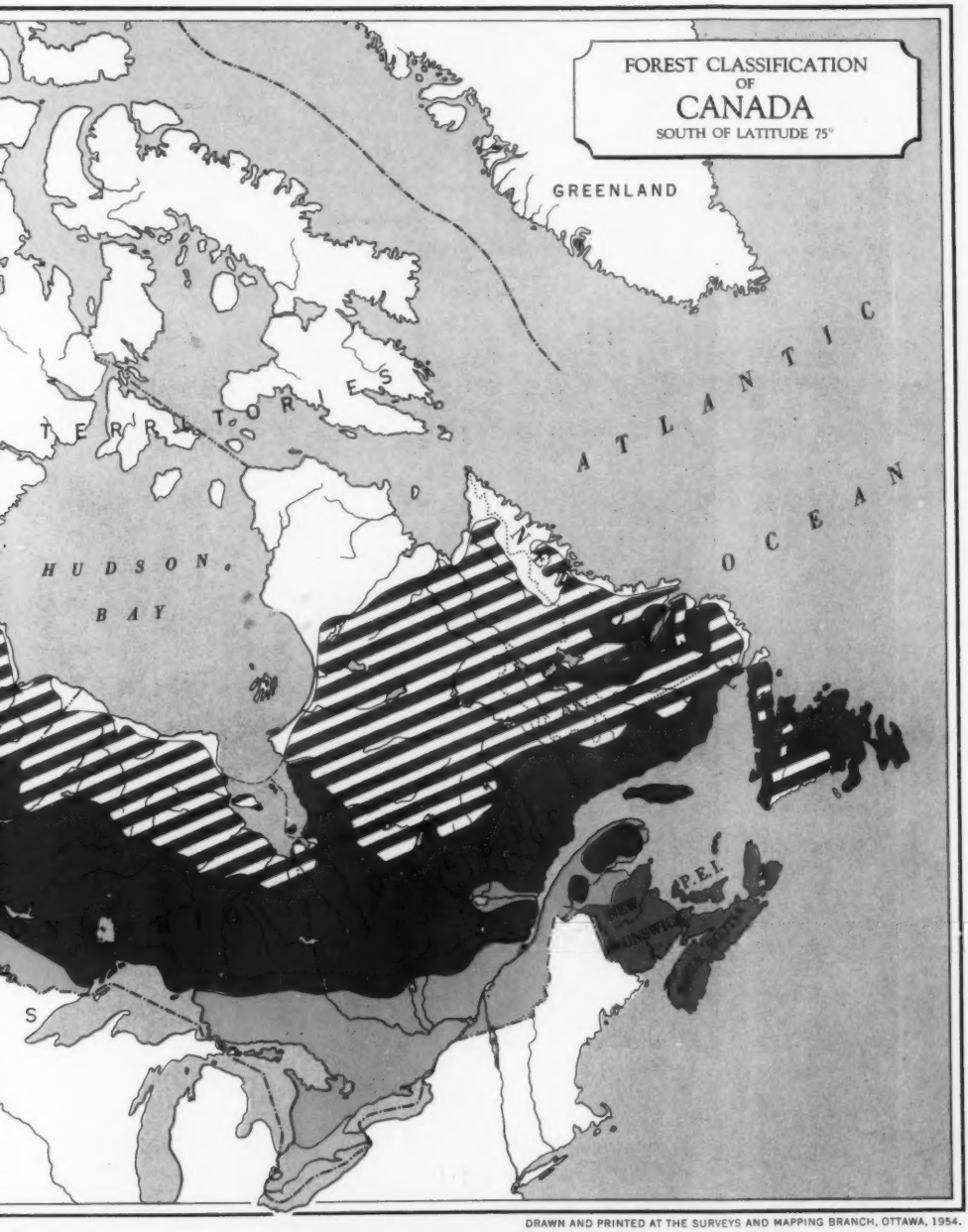


of Experimental Farms Service, Canada Department of Agriculture.

Compiled, and drawn by the Experimental Farms Service, Ottawa, 1950, from base map supplied by the Department of Mines and Resources.

ATION SUPPLIED BY THE FORESTRY BRANCH, DEPARTMENT OF NORTHERN AFFAIRS AND NATURAL RESOURCES.

Fig. 26. Forest classification of Canada. Courtesy of Forestry Branch, Cana



DRAWN AND PRINTED AT THE SURVEYS AND MAPPING BRANCH, OTTAWA, 1954.

Branch, Canada Department of Northern Affairs and National Resources.